

# Essays on Behavioral Pricing

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Outi Somervuori





# Essays on Behavioral Pricing

**Outi Somervuori**

Aalto University publication series  
**DOCTORAL DISSERTATIONS** 124/2012

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ISBN 978-952-60-4797-3 (printed)

ISBN 978-952-60-4798-0 (pdf)

ISSN-L 1799-4934

ISSN 1799-4934 (printed)

ISSN 1799-4942 (pdf)

Images: Desigual (cover)

Unigrafia Oy  
Helsinki 2012

Finland



441 697  
Printed matter

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Outi Somervuori

**Name of the doctoral dissertation**

Essays on Behavioral Pricing

**Publisher** School of Business**Unit** Department of Information and Service Economy**Series** Aalto University publication series DOCTORAL DISSERTATIONS 124/2012**Field of research** Management Science**Abstract**

Pricing is one of the most important marketing decisions for companies. Even a small change in price may have a substantial impact on a company's income. In addition to cost and value information, a company needs to understand how its consumers perceive, process, and respond to prices in order to make optimal pricing decisions. Behavioral pricing focuses on this facet of pricing and on how subsequent behavior may be explained by underlying psychological phenomena. In this respect, behavioral pricing extends, and in many cases challenges, traditional economic pricing research.

This dissertation consists of four individual essays that discuss behavioral pricing. The first Essay reviews the research topics in the field. The aim of the study is to conceptualize the research in behavioral pricing based on previous literature. In addition, the research reviews the main contributions, identifies the main topics and discusses the evolution of the field. The study concludes that research in behavioral pricing has produced much important information and new insights in to pricing. The results of Essay I were used to identify research opportunities in behavioral pricing. One of the most popular fields in behavioral pricing is research on the reference price concept. Reference price is the price consumers use to compare the offered prices of a product or service. The research on reference price is largely concentrated on studying grocery products by modeling scanner panel data.

Given the above, the second Essay of this research concentrates on reference price and especially the consumer behavior when prices are above and below a reference price. Essay II differs from previous research in that the object of the research is a service whose novelty is varied. In addition, the choice-based conjoint method was employed to assess changes in demand. The results highlight the fact that the choice behavior around reference price may not only be loss aversive but also gain seeking and symmetric. Essays III and IV study further the reference price concept. These two studies look at the roles of emotions and approach-withdrawal motivation when prices are above and below a reference price, using psychophysiological measures. The role of emotions has recently received increasing attention in consumer behavior research; however, applications in pricing contexts are rare. Essay IV is the first research that studies the approach-withdrawal motivation in a purchase situation.

These results suggest that the involvement of emotional and motivational processes can be important components of customer behavior around reference price and thus, components of theories such as prospect theory and loss aversion. The ignorance of emotional and motivational factors in pricing decisions and demand estimates may lead to incorrect conclusions. In practice, this suggests that price information should be presented in such a way that it translates into more positive or negative emotions.

**Keywords** behavioral pricing, reference price, emotions, approach-withdrawal motivation, research profiling, conjoint analysis, psychophysiological methods

**ISBN (printed)** 978-952-60-4797-3**ISBN (pdf)** 978-952-60-4798-0**ISSN-L** 1799-4934**ISSN (printed)** 1799-4934**ISSN (pdf)** 1799-4942**Location of publisher** Espoo**Location of printing** Helsinki**Year** 2012**Pages** 195



**Tekijä**

Outi Somervuori

**Väitöskirjan nimi**

Esseitä ostajan hintakäyttäytymisestä

**Julkaisija** Kauppakorkeakoulu**Yksikkö** Tieto- ja palvelutalouden laitos**Sarja** Aalto University publication series DOCTORAL DISSERTATIONS 124/2012**Tutkimusala** Liikkeenjohdon systeemit**Tiivistelmä**

Hinnoittelupäätökset ovat yrityksille elintärkeitä. Jo pienellä hinnan muutoksella voi olla olennainen merkitys yrityksen tulokseen. Perinteisesti yritykset miettivät hinnoittelupäätöksiä arvioidessaan kuluja ja tuotteen/ palvelun arvoa. Sen lisäksi yritysten pitäisi ymmärtää miten ostajan hintamielikuva muodostuu, miten ostajat prosessoivat hintatietoja ja reagoivat eri hintapäätöksiin. Tutkimus ostajan hintakäyttäytymisestä keskittyy hinnoittelun tähän puoleen. Tämä näkökulma laajentaa ja usein myös haastaa perinteisen taloustieteellisen hintatutkimuksen.

Tämä väitöskirja koostuu neljästä esseestä, jotka kaikki käsittelevät ostajan hintakäyttäytymistä hieman eri näkökulmista. Ensimmäisessä esseessä tarkastellaan aiemmin tehtyjä tutkimuksia aiheesta. Työssä käydään läpi alan päätutkimukset, määritellään päätutkimusalat ja keskustellaan alan kehityksestä. Työn pohjalta muodostettiin avoimia tutkimuskysymyksiä, joita on tutkittu esseissä II, III ja IV.

Yksi suosituimmista osa-alueista hinnoittelussa on referenssihintaan liittyvä tutkimus. Referenssihinnan käsite perustuu useihin teorioihin, joiden mukaan ihminen vertaa valintojaan sisäiseen standardiin. Referenssihinnat ovat kuluttajien arviointeja normaaleista hinnoista. Useimmat tutkimukset, joissa on tutkittu referenssihintaan liittyviä asioita, ovat rajoittuneet tutkimaan elintarvikkeita ja mallintamaan paneeliaineistoja tilastollisin menetelmin.

Toinen essee keskittyy referenssihinnan tutkimiseen ja erityisesti asiakkaiden käyttäytymiseen kun hintoja nostetaan tai lasketaan referenssihinnasta. Essee II eroaa aiemmasta tutkimuksesta siten, että työssä tutkitaan palveluita, jotka ovat sekä uusia että olemassa olevia. Lisäksi tutkimus on tehty käyttäen conjoint-analyysiä. Tutkimuksen tulokset osoittavat, että palvelun uutuudesta riippuen asiakkaiden hintakäyttäytyminen voi olla tappioita välttävää, hyötyjä hakevaa tai neutraalia.

Esseissä III ja IV tutkitaan lisää referenssihinnan vaikutuksia. Näissä tutkimuksissa selvitetään tunteiden ja lähentymis- ja loitontumismotivaatioiden vaikutusta ostopäätökseen käyttäen psykofysiologisia menetelmiä. Tunteiden osuutta päätöksentekoon on alettu viime vuosina tutkia yhä enenevässä määrin, mutta vähän jos lainkaan hinnoittelun yhteydessä. Essee neljä on ensimmäinen tutkimus, jossa tarkastellaan lähentymis- ja loitontumismotivaatioiden merkitystä ostopäätöksessä.

Tutkimuksen tulosten mukaan tunteet ja motivaatiot voivat olla tärkeä osa-alue kuluttajien käyttäytymisen selittäjänä kun hinnat eroavat referenssihinnoista. Tämä viittaa siihen, että tunteet ja motivaatio voivat olla myös tärkeitä osia käyttäytymistä selittävissä teorioissa. Kuluttajien tunteiden ja motivaatioiden vaikutuksen aliarviointi hintapäätöksissä ja kysynnän ennustamisessa voi johtaa väärin johtopäätöksiin. Käytännössä hinnat tulisi esittää niin, että ne saavat aikaiseksi positiivisia tai negatiivisia tunteita

**Avainsanat** hinnoittelun psykologia, referenssihinta, tunteet, lähestymis- ja loitontumismotivaatio, tutkimusprofilointi, conjoint-analyysi, psykofysiologiset menetelmät

**ISBN (painettu)** 978-952-60-4797-3**ISBN (pdf)** 978-952-60-4798-0**ISSN-L** 1799-4934**ISSN (painettu)** 1799-4934**ISSN (pdf)** 1799-4942**Julkaisupaikka** Espoo**Painopaikka** Helsinki**Vuosi** 2012**Sivumäärä** 195





# Acknowledgements

When I started my doctoral studies my advisor Professor Merja Halme advised me, among many other things, to enjoy this period of my life. And I have - I have enjoyed this time in so many ways I couldn't have expected in advance. Most of all, because I had the pleasure to work with so many interesting and inspiring people.

First, I would like to thank Merja for her invaluable support and guidance throughout the process. Merja taught me enthusiasm and rigorousness in academic work. Her support has especially been important at the beginning of my studies and in finalizing my dissertation. Merja's encouragement made me become a full time student in the first place. I also admire the way she guided me through and to the end of the process. I also greatly appreciate all valuable comments and suggestions Professor Jyrki Wallenius gave on my dissertation. I am especially grateful to Jyrki for introducing me the topic of behavioral decision-making. Furthermore, I wish to thank Professor Markku Kallio for the advice and comments he gave me. His extensive experience on academic research has been a constant source of new ideas and perspectives. I thank Markku for always encouraging and supporting me. My co-author Professor Niklas Ravaja has also had an important role in my work. Niklas's profound understanding of psychology and psychophysiological methods ensured the good quality of our work. He has had a tremendous impact on my research and future research interests.

I thank the pre-examiners of my dissertation Professor Kent Monroe and Docent Ville Aalto-Setälä for many valuable comments and suggestions. I am grateful to Professor Kent Monroe for accepting the task of opponent. I am honored to receive comments on my dissertation from the leading researcher in the field.

During the years, I have become acquainted with many colleagues. I wish to thank all my colleagues at the department of Information and Service Economy and all the people with whom I worked at the Center for Knowledge and Innovation Research (CKIR). I am most indebted to the people with whom I have worked in various research projects; Assistant Professor Johanna Bragge, Professor Pekka Korhonen, Professor Murat Köksalan and Researcher Mikko Salminen. Your knowledge and experience has been invaluable help in my work. I am grateful to my fellow students Leena Tanner, Hanna Virta, Dr. Petri Hilli and Veli-Matti Rikala. It has been a pleasure to share daily joys and concerns with you. I would

particularly like to thank Jutta Heino and Helena Knuuttila for providing me such a good environment to work at.

A highlight of my studies was a year visit to Scancor at Stanford University. I wish to thank Associate Professor Mitchell Stevens and Anette Eldredge for their great hospitality, and the visiting scholar community for their comments and friendship. Further, I wish to thank Professor Baba Shiv at Stanford Graduate School of Business for inspiration to “Frinky Sciences”.

I wish to express my gratitude to the international pricing community that I have met over the years on Behavioral Pricing Conference. The conference has offered a remarkable opportunity to meet and learn from leading behavioral pricing researchers.

I wish to thank the HSE foundation, Foundation for Economic Education (Liikesivistysrahasto), Aalto University School of Business Visiting Researcher Fund, Jenny and Antti Wihuri Foundation, Wallenberg Foundation, Fazer Oy, and SOK for financially supporting my work.

Finally, I would like to thank my family and friends. I am especially grateful to my husband Jouni Ikonen whose open-mindedness and innovativeness along with good sense of humor have been great help in my work as well as in other areas of life. Our daughters Jenni and Veera Ikonen are the joy of my life. I am grateful to all three of you for your love and support – you make my life important. I wish to thank my parents Irja and Antti Somervuori as well as my parents in law Hannele and Hannu Ikonen for always encouraging me in my work. I also greatly appreciate all your help to our family. I don’t know how our family could manage without you. Further, I wish to thank my sister Elina Somervuori and her family. Elina has always been the one to whom I can turn to with all my concerns, no matter how silly they are. I am very lucky to have many dear friends too. I am especially grateful to Elina Retva and Hanna Seppälä for always being there for me.

Helsinki, September 7, 2012

Outi Somervuori

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Essay II: Halme Merja and Somervuori Outi: How do prices above and below the reference price affect the demand for a service? A conjoint analysis approach.

Essay III: Somervuori Outi and Ravaja Niklas: Purchase Behavior and Psychophysiological Responses to Different Price Levels.

Essay IV: Ravaja Niklas, Somervuori Outi and Salminen Mikko: Predicting purchase decision: The role of hemispheric asymmetry over the frontal cortex. Forthcoming in Journal of Neuroscience, Psychology, and Economics.



# Part I

## Overview of the dissertation





# 1. INTRODUCTION

## 1.1 Background

Pricing is a field of study that lends itself to economics, marketing, accounting, and behavioral psychology. The determination of a price is not only a central issue for a company but also for the economy as a whole. Thus, pricing has been extensively studied in many fields. This research examines pricing from a marketing point of view, and seeks to enhance our understanding, especially of consumer price behavior; a topic called behavioral pricing.

Pricing research in marketing typically considers topics that are important from a company's perspective with regard to defining pricing strategies and tactics. In general, pricing managers in companies are well informed of the costs of providing their product or service (Dolan and Simon, 1996). However, for a company to correctly set its prices also needs the information about customers' responses to price changes, customers' willingness-to-pay for a product or service, and about how customers process price information. These points are influenced by psychological and behavioral aspects that typically are not considered when setting prices (Dolan and Simon, 1996). The low attention paid to psychology by economists began with the neoclassical revolution. Economists thought psychology provided too unsteady foundation for economics (Camerer and Loewenstein, 2004). Nowadays, the behavioral perspective of theories has been widely studied; e.g. in decision-making and finance. However, the number of research articles on behavioral pricing is relatively small. This is interesting because price is the only marketing decision variable that generates revenue. It should be vitally important for companies to understand how the pricing in practice affects customers and how the impact on customers affects demand.

This research reviews the behavioral pricing literature in general and concentrates especially on research on reference price and how consumers react to prices that are above and below the reference price. The marketing literature generally agrees that consumers evaluate product prices in

comparison with a reference price (Monroe, 1973). However, the results of research studying consumer reactions to prices that are above and below a reference price are not consistent. Prospect theory (Kahneman and Tversky, 1979), presents a value function that suggests that consumers react more to losses (prices above a reference price) than to gains (prices below a reference price) for small equivalent price changes from the same reference point. This phenomenon we call loss aversion in value. However, prospect theory does not necessarily imply a similar reaction in demand; i.e., loss aversion in value does not imply loss aversion in demand (Kallio and Halme, 2010). The phenomenon has been extensively studied by statistically modeling the consumer value function on scanner panel data of frequently purchased grocery products. However, empirical results are mixed; some research concludes that consumers are more responsive to losses, and other research concludes that consumers are more responsive to gains, while some studies report symmetric behavior (Bell and Lattin 2000; Mazumdar and Papatla 1995; Putler, 1992; Terui and Dahana, 2006).

This research extends the above discussion. The aim is to look at the demand reaction around reference price and to understand the emotional and motivational responses elicited by price changes and the brand. In this study I apply psychophysiological measures to study emotional and motivational responses: facial electromyography (EMG), electrodermal activity (EDA), and electroencephalography (EEG). Psychophysiological measures provide continuous information on individuals' emotional, motivational, and attentional processes. Psychophysiological measures are widely used in psychology; however, there is relative paucity of psychophysiological studies in marketing. The most apparent reason for the limited use is that psychophysiological methods often require expensive measurement equipment and specialized experience. However, psychophysiological and neurophysiological measures may provide information about various marketing-related phenomena that may not be reached by more conventional research methods (Ravaja 2004, Shiv et al. 2005). Their use would lead to a more complete and objective understanding of consumer desires, and consequently could assist companies to adjust their strategies. Such an approach allows an objective perspective to phenomena since the measurement does not rely on respondents' ability to describe the problem, and social desirability bias may be eliminated (Hubert and Kenning 2008).

## **1.2 Objectives and research problem**

This research seeks to extend the discussion on behavioral pricing in marketing literature.

The research questions are:

Q1: What are the main topics and contribution of behavioral pricing research?

Q2: How consumers react to prices that are above and below a reference point for a service?

Q3: What is the role of emotions in purchase decisions when price level is changed?

Q4: What is the role of approach/ withdrawal motivation in purchase decisions when price level is changed?

The four essays seek to answer these questions. Essay I discusses what behavioral pricing is. The aim of the research is to conceptualize the research in behavioral pricing based on previous literature. In addition, the research reviews the main contributions, identifies main topics and discusses the evolution of the field. Essay II selects a topic in behavioral pricing to be studied further: the reference price. The objective of the research is to look at consumer behavior around reference price when prices are above and below the reference price for a service, using conjoint analysis. Essays III and IV study further the consumer behavior around reference price and seek to elaborate reasons for consumers' varying behavior. Essay III looks at the role of emotions in purchase decision when price level and brand are varied; using facial electromyography (EMG) and electrodermal activity (EDA). Essay IV considers the role of approach-withdrawal motivation in the same situation, using electroencephalography (EEG).

## **1.3 Outline of the dissertation**

This dissertation consists of two parts: overview and the original four essays. The overview includes an introduction to the research and research problem. Thereafter the theoretical background is briefly described, and used methods introduced. Section four of the overview briefly summarizes the results and contributions of the four essays. The final section discusses the conclusions and contribution of the research.

Part two of the research includes the original essays.

Essay I: Somervuori O: Profiling behavioral pricing research in marketing.

Essay II: Halme M and Somervuori O: How do prices above and below the reference price affect the demand for a service? A conjoint analysis approach.

Essay III: Somervuori O and Ravaja N: Purchase Behavior and Psychophysiological Responses to Different Price Levels.

Essay IV: Ravaja N, Somervuori O and Salminen M: Predicting purchase decision: The role of hemispheric asymmetry over the frontal cortex.

## 2. THEORETICAL BACKGROUND

The essays discuss behavioral pricing. Therefore, first, the topic behavioral pricing is introduced. The research then concentrates on studying reference price and consumer reaction to prices that are above and below the reference price. Prospect theory offers a framework to study consumer reactions to price changes from the reference price. Therefore, the second section reviews prospect theory and its applications in pricing literature. Further, the aim of the dissertation is to look at the roles of emotions and approach-withdrawal motivation on reference price. The last two sections review the theories underlying these two concepts.

### 2.1 What is behavioral pricing?

Behavioral pricing research uses theories from social cognition and behavioral decision research and applies them in pricing contexts. Since the term “behavioral pricing” is fairly new no clear conceptualization exists. Miyazaki (2003, p 471) defines behavioral pricing as follows: “Behavioral pricing constitutes an expansive subset of pricing research wherein prices and pricing are examined with respect to their human elements – that is, with respect to how humans attend to, perceive, process, and evaluate price information, as well as how they go about determining the price at which a particular item should be sold or purchased.” The major subfields discussed in behavioral pricing defined in Essay I are: 1) Price/ perceived quality relationship, 2) Reference price, 3) Price awareness, 4) Measurement of willingness-to-pay WTP, 5) Heuristics and biases, and context in pricing, 6) Price fairness, and 7) Price-endings. These subfields are discussed in more detail in Essay I.

Research in behavioral pricing has produced a lot of important information, especially on how people perceive prices. The most researched areas in behavioral pricing are price-quality relationship and reference price (Essay I). Contemporary research recognizes, for example, that price and perceived quality are in many ways codependent (Zeithaml, 1988) and that consumers use a reference price to compare a product’s price rather than consider only the perceived value or utility of the product (Kalyanaram

and Winer, 1995). Other areas are also emerging, as evidenced by the growth in the annual number of research publications in each area (Essay I). For example, research generally agrees that fairness is an important construct in evaluating whether a product's price is reasonable, acceptable, or justifiable relative to the comparative product's price (Xia, Monroe and Cox, 2004).

However, considering the importance of pricing decisions to companies, the amount of research in all areas is small. All the subareas in behavioral pricing would benefit from additional research. This dissertation extends the research on reference price. In addition, the roles of emotions and approach-withdrawal motivation in pricing are studied. These concepts have recently received more attention in consumer behavior research; however, applications in the pricing context are rare.

## 2.2 Prospect theory and reference price

Prospect theory, developed by Kahneman and Tversky (1979), is a descriptive model of decision-making under risk. Kahneman and Tversky found empirically that people sometimes violate the expected utility theory and as a response developed an alternative model that takes into account anomalies and contradictions of human behavior. Prospect theory defines a value function over gains and losses from a reference point; as presented in Figure 1.

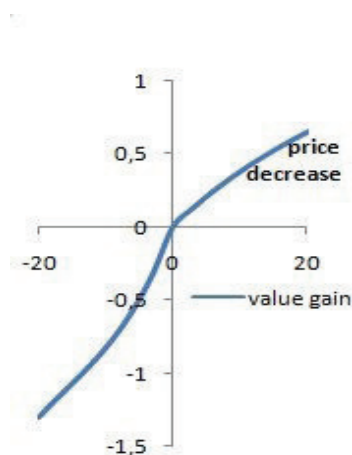


Figure 1. Value function according to prospect theory

Prospect theory has three main characteristics. Firstly, choices are evaluated by deviations from some reference point in terms of gains and losses. Secondly, the value function is an S-shaped curve that is concave for

gains (implying risk aversion) and convex for losses (implying risk seeking). The marginal value diminishes for both losses and gains as their size increases. Thirdly, the value function is steeper for losses than for gains in the neighborhood of the reference point. The phenomenon is called loss aversion.

A reference price is the price that consumers use to compare the offered price of a product or service (Monroe, 1973). A price above a reference point represents “loss” and a price below a reference point represents “gain”. The research on reference price discusses the formation of reference prices and its influence on utility. The reference price and the formation of reference prices has been accepted as an empirical generalization in marketing (Kalyanaram and Winer 1995); however the conclusions of reference price effects on purchase decisions and on demand or utility are somewhat mixed. The cues that influence the reference price are focal, contextual, and organic (Della Bitta & Monroe, 1974; Della Bitta, Monroe & McGinnis, 1981). Focal cues are the immediate focus of attention, e.g., a price under consideration. Contextual or background cues are all other stimuli in the situation providing the context within which the focal cues are operative, e.g., available monetary resources, purpose of purchase, and the purchase environment including other offers. Organic cues refer to inner physiological and psychological processes affecting behavior (Monroe, 2003).

Several studies have looked at the asymmetric reference price effect and loss aversion. However, empirical results are mixed; some concluding that consumers are more responsive to losses, others that consumers are more responsive to gains, and some studies reporting symmetric behavior. Most of the research in this field statistically model consumer panel data (e.g. Bell and Lattin, 2000; Hardie, Johnson and Fader, 1993; Krishnamurthi, Mazumdar and Raj, 1992; Mazumdar and Papatla, 1995; Putler, 1992) and use frequently purchased grocery products as an example.

Some studies have tried to identify the characteristics that will lead to loss averse or gain seeking behavior. Krishnamurthi et al. (1992) concluded that loyal customers exhibit symmetric behavior towards losses and gains, whereas non-loyal customers show strong asymmetry. Non-loyal customers are more responsive to gains than to losses. A possible explanation is that the non-loyal customers may be more price sensitive to price.

Klapper et al. (2005) found that non-quality conscious consumers exhibit loss aversion and quality conscious exhibit less loss aversion. Hankuk and Aggarwal's (2003) experiment on high and low quality-tier products identified that loss aversion occurred only with low quality-tier products.

Consumers showed gain seeking behavior towards products that have high quality-tiers.

In the margarine and liquid detergent category, consumers behaved differently in their choices around the reference price. Margarine shoppers were more responsive to gains, whereas liquid detergent shoppers were more responsive to losses. Mazumdar and Papatla (1995) suspect that the reason lies in the differences in promotional levels - the level of promotion is much higher in liquid detergents than in margarine, and consumers may exhibit greater aversion to paying regular prices.

## 2.3 The theory of emotions

Emotions are biologically based action dispositions that have an important role in the determination of behavior (Lang, 1995). Most theories suggest that emotions have three components: subjective experience (e.g. feeling joyous), the expressive component (e.g. smiling), and the physiological component (e.g. sympathetic arousal). To make a decision people use both cognition and emotions. Recent research in decision-making suggests that emotions play an important role in decision-making (Vohs, Baumeister and Loewenstein, 2007).

According to the two-dimensional theory of emotions, all emotions can be located in a two-dimensional space; the axes are valence and arousal, as presented in Figure 2 (Lang 1995, Larsen and Diener 1992).

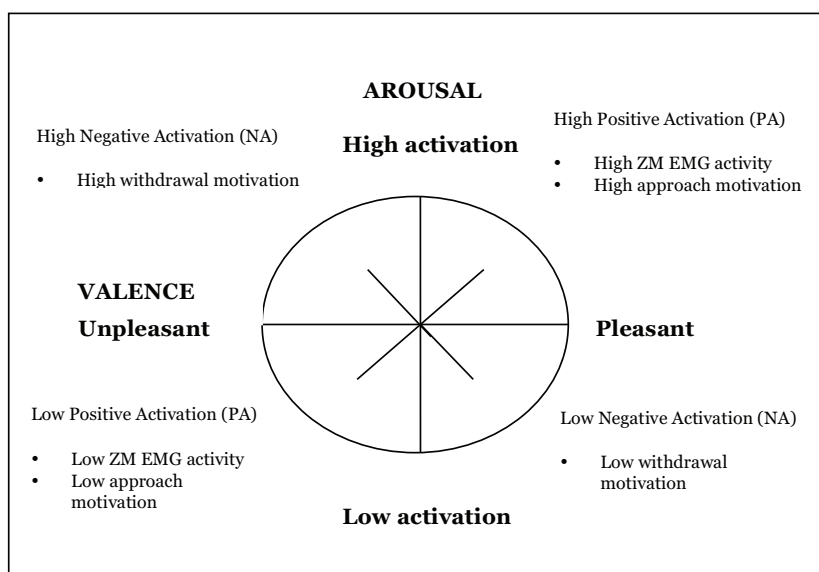


Figure 2. A schematic representation of the two-dimensional structure of emotions (Larsen and Diener, 1992; Ravaja 2004).



The valence dimension refers to the hedonic quality, or pleasantness, of an experience and ranges from unpleasant to pleasant. The arousal dimension refers to the perception of arousal associated with such experience.

The theory suggests that the two main, orthogonal dimensions of emotional experience are negative activation (NA) and positive activation (PA); representing a 45° rotation of the valence and arousal axes (Watson and Tellegen 1985; Watson, Wiese, Vaidya and Tellegen, 1999). The NA axis extends from highly arousing negative emotion (e.g., fear and anger) at one end, to low-arousal positive emotion (e.g., pleasant relaxation) on the other, while the PA axis extends from highly arousing positive emotion (e.g., joy, enthusiasm), to low-arousal negative emotion (e.g., depressed affect; Figure 2). Negative activation is associated with avoidance or inhibition, while positive activation is related to approach motivation, such as higher purchase intent (Andrade 2005; Frijda 1986).

## **2.4 Approach/ withdrawal motivation**

Approach-withdrawal is a distinction being used to explain and predict motivated behavior. Approach motivation is defined as the energization of behavior by, or the direction of behavior toward, positive stimuli. While withdrawal motivation is the energization of behavior by, or the direction of behavior away from, negative stimuli (Elliot, 2006).

Pleasant and unpleasant valence is conceptualized as the core evaluative dimension of approach-withdrawal motivation. Approach motivation is associated with positive activation (PA) axis in Figure 1 and withdrawal motivation is associated with negative activation (NA) (Watson and Tellegen 1985; Watson et al. 1999). In addition, the approach-withdrawal distinction is fundamental and basic to motivation (Elliot, 2006). Research indicates that humans automatically evaluate most, if not all, encountered stimuli on a positive/negative dimension (Wyer and Bargh, 1997), and that these evaluations instantaneously evoke approach and avoidance behavioral predispositions (Lewin, 1935).

Recent research in psychology has suggested that the prefrontal cortex of the brain is critically involved in emotional and motivational processes. The prefrontal cortex is located in the frontal lobes area of the brain. The left prefrontal cortical region is associated with approach motivational and/ or positive emotional processes and the right prefrontal cortical region associated with withdrawal motivational and/ or negative emotional processes (for reviews see Coan & Allen, 2004; Davidson, 2003).

### 3. RESEARCH METHODS

Each of the four essays in this research use different methods. The methodological aspects are summarized in Table 1. Essay I includes both qualitative and quantitative analysis of textual data. Essay II uses quantitative methods to analyze data collected in a survey. Essays III and IV use data collected from the same experiment. However, the psychophysiological measures used in the experiment are different in these essays. In the following sections the methods are discussed in more detail. Since both Essays III and IV use psychophysiological measures the methods are presented in the same section.

Essay	Method	Data	Data analysis	Context
I	Literature review	290 articles from ISI Web of Science	Traditional literature review and research profiling	Behavioral pricing articles
II	Conjoint survey	1 141 teachers (response rate 33%)	Conjoint-analysis	Old and new copyright licenses
III	Facial electromyography (EMG) and electrodermal activity (EDA)	33 students in a laboratory experiment	Semiparametric regression technique – Generalized Estimating Equations (GEE)	Shopping of grocery items
IV	Electroencephalography (EEG)			

Table 1. Methodological structure of the research.

### 3.1 Traditional literature review and research profiling

The first Essay uses two methods to review the previous literature on behavioral pricing: a traditional literature review, and research profiling. The objectives of a traditional literature review are e.g., to describe the key concepts of the field and review relevant prior literature (Webster & Watson, 2002).

To augment the traditional literature review, research profiling was used to review the literature on a large scale. Research profiling uses modern search engines, electronic science databases and sophisticated text mining. While the number of references in traditional literature reviews may be from tens to hundreds, the number in research profiling may be up to 20 000 (Porter and Cunningham 2005). The purpose of research profiling is to understand the structure of a subject, important variables, pertinent methods, and key needs (Porter, Kongthon and Lu 2002).

Research profiling is based on bibliometrics; a method to study text and information. Typical bibliometric studies examine item occurrences and co-occurrences, for example, see Baumgartner (2010) for a bibliometric study on consumer research. Typical questions in bibliometric studies are, who are the prolific authors, what are the subjects most studied, and when have the subjects been studied? Research profiling extends the scope of bibliometric studies by examining the search words with text-mining tools (Yang, Akers, Klose and Barcelon Yang, 2008) in order to identify networks, patterns, by visually representing the data. Research profiling has been used, for example, to review pricing (Leone, Robinson, Bragge and Somervuori, 2011) and gaming literature (Bragge, Thavikulwat and Töyli, 2010). The key differences between traditional literature reviews and research profiling are summarized in Table 2.

<b>Traditional literature review</b>	<b>Research profiling</b>
<b>Micro focus (paper by paper)</b>	Macro focus (patterns in the literature as a body)
<b>Narrow range (~20 references)</b>	Wide range (~20 – 20 000 references)
<b>Tightly restricted to the topic</b>	Encompassing the topic + related areas
<b>Text discussion</b>	Text, numerical, and graphical depiction

Table 2. Comparison: traditional literature review vs. research profiling (Porter, Kongthon & Lu, 2002).

The traditional literature review analyses include a brief introduction by reviewing the relevant research conducted under the theme. Thereafter, the main subjects discussed in each theme are identified and presented as cluster maps. The software used, VantagePoint, permits advanced analyses such as cluster maps using Aduna software (VantagePoint, 2011; Aduna Softwares, 2011). The main purpose of cluster maps is to show which key terms appear in the same articles.

The research profiling analyses include basic listings of number of articles by author, institution, and journal. In addition, cross-tables are used to identify trends in time. In this study we also used auto-correlation matrixes to characterize the field and auto-correlation maps to visualize the linkages between the key terms. The auto-correlation matrix is calculated using a co-occurrence matrix in which articles are rows and key terms are columns. The numbers in this co-occurrence matrix are either 1 or 0; 1 referring to that the key term appears in the article, and 0 if it is absent. Thereafter, the Pearson's correlation coefficient is calculated to measure the co-occurrence of any two key terms being used in the same record. For example, an auto-correlation matrix of key terms will indicate key terms that are often used together.

The auto-correlations are visualized in a map produced through multidimensional scaling (MDS), a figure called an auto-correlation map. The maps are produced applying MDS to the auto-correlation matrix. The MDS algorithm simply tries to reduce an N-dimensional representation to two dimensions (N being the number of key terms); thereby seeking to maintain key terms with high correlation in close proximity to each other. The x- and y-axes of the maps have no specific meaning. Generally speaking, key terms that are close to each other are more similar than those that are farther away. However, the presence or absence of a line (and the thickness of the line) between any two key terms are more appropriate measures of proximity, because it implies a relatively high correlation between them.

### **3.2 Conjoint analysis**

Conjoint analysis (CA) is a statistical method to determine how people value different product/ service features. A product or service is described in terms of attributes, and price may be one of the attributes. For example, for a memory stick the types of attributes could be brand, amount of memory, and price. Each attribute can be broken down to many levels, e.g. levels of memory could be 2 GB, 4 GB, 8 GB or 16 GB. The respondents are asked to evaluate the value of different attribute levels. In choice-based

conjoint analysis (CBC) respondents are presented with a set of concepts from which they are asked to choose the best alternative. Choosing a product from a group of products is assumed to simulate the natural shopping situation. On the basis of the selected choices the respondent's value function is estimated in individual or aggregate level. The sets of concepts are presented in a web-based questionnaire.

The total utility of a product/ service is assumed to be a function of attribute values. Utility functions  $U$  measure perceived value and consist of the deterministic part called the value function (the total value  $V$ ) and the random error term  $\varepsilon$ :

$$U = V + \varepsilon. \quad (1)$$

Choice-based conjoint analysis (CBC) can use the simple additive value function, with  $P$  attributes  $a_1, a_2, \dots, a_P$ :

$$V = v_1(a_1) + v_2(a_2) + \dots + v_P(a_P) \quad (2)$$

where  $v_1, v_2, \dots, v_P$  are value functions for the attributes.

A more general value function takes into account attribute interactions. Assume that one 2-way interaction term of attributes  $i$  and  $j$ ,  $i \neq j$ , is included. Then the total value  $V$  becomes

$$V = v_1(a_1) + v_2(a_2) + \dots + v_P(a_P) + v_{P+1}(a_i, a_j), \quad (3)$$

where  $v_{P+1}$  is a value function of two attributes.

The choice model that CBC uses is multinomial logit. The error terms are assumed to be independent and identically Gumbel-distributed (Bierlaire, 1997). When  $k$  profiles with the corresponding total values  $V_1, V_2, \dots, V_k$  are offered for evaluation, the probability that the  $k^{\text{th}}$  profile ( $i=1, \dots, k$ ) is chosen is

$$\exp(V_i) / [\exp(V_1) + \exp(V_2) + \dots + \exp(V_k)], \quad (4)$$

In this study, the individual value functions were estimated using Hierarchical Bayes estimation (Lenk, DeSarbo, Green and Young, 1996). This is a standard estimation method when individual utilities are used. Its measure of fit, root likelihood (rlh), is the geometric mean of the probabilities that the estimated utilities predict the correct concept choices.

It can be compared with uniform choice probability which is, in the case of  $k$  alternatives in each choice task,  $1/k$ .

### **3.3 Psychophysiological measures**

The psychophysiological measures used in this dissertation were electromyography (EMG), electrodermal activity (EDA) and electroencephalography (EEG). These measures were used because of their value as indices of emotional and motivational processes, as explained below. The data recorded with these measures were analyzed using a semiparametric regression technique, Generalized Estimating Equations (GEE).

#### **3.3.1 Facial muscle activity/ Electromyography (EMG)**

EMG is a technique to record facial muscle activity. Facial EMG activity was recorded from the left corrugator supercilii (brow area) and zygomaticus major (cheek area). The electromyographic signals associated with muscle activity have been of interest for long time owing to their value as indices of and possible contributors of behavioral processes (Tassinari and Cacioppo, 2000).

EMG provides a direct measure of the electrical activity associated with facial muscle contractions that are an important form of emotional expression (Tassinari and Cacioppo, 2000). According to the emotion-expression perspective, facial displays express a person's internal emotion state (Ekman, 1993). A number of studies have shown that the processing of pleasant emotions is associated with greater activity over the zygomaticus major (cheek) muscle region and that processing unpleasant emotions is associated with greater activity over the corrugator supercilii (brow) muscle region during affective imagery (Ravaja, Saari, Kallinen and Laarni 2006, Witvliet and Vrana, 1995) and when presented with affective still and moving images (Lang, Greenwald, Bradley and Hamm, 1993; Simons, Detenber, Roedema and Reiss, 1999), written words (Larsen, Norris and Cacioppo 2003), 60-second radio advertisements (Bolls, Lang and Potter 2001), video news messages (Ravaja, Kallinen, Saari and Keltikangas-Järvinen 2004, Ravaja et al. 2006), and textual news messages (Ravaja et al. 2006).

### **3.3.2 Electrodermal activity (EDA)**

EDA measures the electrical changes in human skin. It has been one of the most widely used response systems in the history of psychophysiology. It has been identified to be a valid measure of arousal (e.g. Wang and Minor, 2008, Groeppel-Kein, 2005). Several studies using pictures have shown that EDA is highly correlated with self-reported emotional arousal (Lang et al., 1993).

### **3.3.3 Brain response using electroencephalography (EEG)**

The measurement of brain electrical activity using electroencephalography (EEG) provides a method to directly measure brain function and make inferences about regional brain activity (Davidson, Marshall, Tomarken and Henriques, 2000). EEG can be used effectively to study motivational, attentional and memory processes (Klimesch, 1999; Aftanas and Golosheikine, 2001).

According to Davidson's influential approach-withdrawal motivational model of emotion, the left- and right-anterior brain regions are part of two separate neural systems underlying approach and withdrawal motivation, respectively (e.g., Davidson, 1995, 2004). Relatively greater left frontal activity indicates a propensity to approach or engage a stimulus, while relatively greater right frontal activity indicates a propensity to withdraw or disengage from a stimulus (for reviews, see Coan and Allen, 2004; Davidson, 2003; Demaree, Everhart, Youngstrom, and Harrison, 2005). Frontal asymmetry (i.e., the index of frontal asymmetry in EEG studies) has indicated that it reflects activity in the prefrontal cortex (PFC; Pizzagalli, Sherwood, Henriques, and Davidson, 2005).

A relationship between emotional states and concomitant changes in frontal EEG asymmetry has also been established; that is, approach-related emotions (e.g., joy and anger) are associated with relatively greater left frontal activation, whereas withdrawal-related emotions (e.g., disgust and fear) are associated with relatively greater right frontal activation (e.g., Coan and Allen, 2003; Davidson, Ekman, Saron, Senulis, and Friesen, 1990; Ekman and Davidson, 1993; Harmon-Jones, Sigelman, Bohlig, and Harmon-Jones, 2003). Davidson, Marshall, Tomarken, and Henriques (2000) have argued that anterior asymmetry is associated with pre-goal attainment emotion elicited while attempting to achieve a goal (e.g., enthusiasm), but not with post-goal attainment emotion (e.g., contentment; cf. the distinction between wanting and liking; see also Tomarken and Zald, 2009). The state engagement in approach-related responses and perceived

high as compared to low choice to engage in action (commitment to counterattitudinal or proattitudinal action) has been shown to increase left-sided frontal activity (Amodio, Devine, and Harmon-Jones, 2007; Harmon-Jones, Harmon-Jones, Serra, and Gable, 2011; see also Harmon-Jones, Lueck, Fearn, and Harmon-Jones, 2006).

### **3.3.4 Generalized Estimating Equations (GEE)**

Psychophysiological data were analyzed using the Generalized Estimating Equations (GEE) procedure in SPSS. GEE is a semiparametric regression technique. In the GEE procedure, the dependent variable is linearly related to the factors and covariates via a specified link function. The model allows for the dependent variable to have a non-normal distribution and covers widely used statistical models (e.g., logistic models for binary data). The GEE procedure extends the generalized linear model to allow for analysis of repeated measurements or other correlated observations. The GEE approach requires the specification of the correlation structure of the repeated observations of the dependent variable, distribution of the dependent variable, and link function. The GEE models were introduced by Liang and Zeger (1986), and the method has received wide use in medical and life science research (Ballinger 2008).



## 4. OVERVIEW OF THE FINDINGS

The following section will summarize the four essays and their main contributions.

### 4.1 Essay I: Profiling behavioral pricing research in marketing

The first Essay discusses what behavioral pricing is. The objective of the research is to conceptualize the research in behavioral pricing based on previous literature. In addition, it reviews the main contributions, identifies main topics and discusses the evolution of the field.

To address the objectives the research presented in this essay examines 290 articles found in the ISI Web of Science database focusing on marketing journals that discuss behavioral pricing. The articles are reviewed using traditional literature review and research profiling methods. The purposes of traditional literature reviews are e.g., to describe the key concepts of the field and review relevant prior literature, (Webster and Watson, 2002). Research profiling answers questions such as who, what, where, and when (Porter et al., 2002; Porter and Cunningham, 2005). The answers are provided using simple frequency lists (e.g. top-25 lists), two-dimensional tables (e.g. subject area counts by 3-year periods), and trend figures (e.g. the number of publications yearly). Furthermore text-mining tools make it possible to conduct advanced statistical analyses (correlation and cluster analyses) on textual data and to visualize the results using multidimensional scaling maps.

The main subfields in behavioral pricing identified in the study are: price-quality relationship, reference price, price awareness, measurement of willingness-to-pay (WTP), heuristics and biases, and context in pricing, price fairness, and price-ending. Price-quality relationship and reference price are the most popular subfields studied in terms of number of articles published in marketing journals. In general, the behavioral pricing field is relatively new and the total number of studies in all the subfields is small.

The study concludes that research in behavioral pricing has produced important information especially on how people perceive prices. Contemporary research recognizes, for example, that price and quality are in many ways codependent (Zeithaml, 1988) and that consumers use a reference price to compare a product's price rather than consider only the perceived value or utility of the product (Kalyanaram and Winer, 1995). Other areas are also emerging as evidenced by the fact that the yearly quantity of research in each area is growing. The importance of the smaller research areas is, however, well recognized. For example, research generally agrees that fairness is an important construct in evaluating whether a product's price is reasonable, acceptable, or justifiable relative to the comparative product's price (Xia et al., 2004).

The results suggest that all subfields would benefit from more research, especially research that would concentrate on understanding the processes underlying different behavior, and research in a greater variety of contexts and cases. In addition, the internet has changed the way consumers process price information. The changed behavior creates a need to revisit the old pricing problems. Furthermore, inclusion of the new emerging topics, such as emotions, in behavioral pricing research could provide new insights.

The contribution of the study is that it provides an introduction to the field for new researchers. For the behavioral pricing community the study conceptualizes the field based on previous literature and identifies the main contribution and main topics discussed. The study also suggests new research ideas. In addition, this study introduces research profiling to behavioral pricing researchers.

#### **4.2 Essay II: How do prices above and below the reference price affect the demand for a service? A conjoint analysis approach.**

The second Essay selects the reference price concept to be studied further. The objective of the research is to look at consumer reaction to prices that are above and below a reference price, using conjoint analysis.

Prospect Theory is used as a framework in this study (Kahneman and Tversky, 1979). Prospect theory defines a value function over gains and losses from a reference point; the reference point causes a kink in the value function, and the function is steeper for losses than for gains. The phenomenon that people are more responsive to losses than to gains is called loss aversion. In the pricing literature, the idea is that a price above a reference point represents a "loss" and a price below a reference point

represents a “gain” (Hardie et al., 1993; Putler 1992; Terui and Dahana 2006).

Many of the studies in this area statistically model scanner panel data and define loss aversion on the basis of changes in perceived value (Bell and Lattin 2000; Hardie et al.1993; Krishnamurthi et al., 1992; Mazumdar and Papatla 1995; Putler 1992). This approach to studying consumer choice around reference prices has resulted in mixed results. Some studies have discovered effects supporting loss aversion (Hardie et al., 1993; Kalyanaram and Winer 1995, Putler, 1992; Terui and Dahana, 2006). Another stream of studies identified mixed results (Bell and Lattin 2000; Klapper et al., 2005; Krishnamurthi et al. 1992; Mazumdar and Papatla 1995).

The objective of our study was to study how do a price that is higher than the reference price and a price that is lower than the reference price (the price difference from the reference price being equal in magnitude) affect purchase probability or relative demand of a service? The idea was to study whether the choice behavior is symmetric, loss averse, or gain seeking in demand. In addition, we looked at whether the choice behavior is different towards services that differ in their novelty. Our study is different from previous studies in many significant ways. Firstly, instead of using scanner panel data, we use survey data and analyze it with conjoint analysis. Secondly, we study a service, not a product. Thirdly, we define loss aversion on the basis of changes in demand rather than value, since demand is more interesting from the marketing point of view.

The results indicate that consumer behavior around reference price is mixed. Our study suggests that the behavior is more loss averse towards traditional services and more gain seeking towards new services.

Among the contributions of the study are that it introduces a new method, conjoint analysis, to study reference price behavior and extends the reference price research to the area of services marketing. The method allows the use of wider variety products/ services and contexts. In addition, the research results highlight the importance that the behavior around reference price may not only be loss averse but also gain seeking and symmetric.

#### **4.3 Essay III: Purchase Behavior and Psychophysiological Responses to Different Price Levels**

The third and fourth Essays study further the behavior around the reference price and seek to find reasons for consumers’ varying behavior. Essay three looks at the role of emotions in purchase decisions when prices are varied using psychophysiological measures. The role of emotions has

recently received increasing attention in consumer behavior research, for example, emotions have been found to have a significant role in decision-making (Vohs et al., 2007). However, applications in pricing contexts are rare, as identified in the first Essay.

The research was conducted as a laboratory experiment and the processing of emotions was measured using psychophysiological measures. The idea in the experiment was to study participants' purchase behavior and psychophysiological reactions when product prices were above and below a normal price for brand and store labeled products in seven different product categories. The psychophysiological measures recorded were facial electromyography (EMG) and electrodermal activity (EDA).

Facial electromyography (EMG) provides a direct measure of the electrical activity associated with facial muscle contractions that are an important form of emotional expression (Tassinari and Cacioppo 2000). A number of studies have shown that the processing of pleasant emotions prompts greater activity over the zygomaticus major (cheek) muscle region during affective imagery (Ravaja et al. 2006; Witvliet and Vrana 1995), and when presented with affective still and moving images (for 6 s, Lang et al. 1993; Lang 1995; Simons et al. 1999).

Electrodermal activity (EDA), commonly known as skin conductance, is an important psychophysiological index of arousal (Wang and Minor, 2008, Groeppel-Kein, 2005). Several studies using the picture-viewing paradigm have shown that EDA is highly correlated with self-reported emotional arousal (Lang et al. 1993).

To better understand consumer behavior, we considered the direct influence that emotions have on purchase decisions and the influence that price and brand have on the elicitation of emotions. We found that increased zygomatic EMG activity (an index of positive emotions and approach motivation) predicted an affirmative decision to purchase a product. When we looked at the elicitation of zygomatic EMG activity, we found that low prices elicit significantly more zygomatic EMG activity than does high prices.

Price and brand have also direct influence on purchase decisions. The results suggest that a low price level and private label product predict affirmative purchase decisions. As private label products are cheaper they may induce direct positive influence on purchase decisions. However, the brand products seem to elicit more positive emotions. It may be that via increased positive emotions/ approach motivation the reaction to price changes is stronger for brand products than for private label products.

This study improves our understanding of the underlying reasons for consumer behavior around reference price. We have learned more about

the emotional processes affecting purchase decisions as well as the relationship between price, brand, and emotions. This information will improve pricing managers' and researchers' ability to estimate consumers' demand reactions to price differences from a normal price level. A secondary contribution of the study is that it introduced the psychophysiological methods to the pricing community. These methods may have a valuable role in future pricing research.

#### **4.4 Essay IV: Predicting purchase decision: The role of hemispheric asymmetry over the frontal cortex**

As mentioned above, Essay IV studies further behavior around reference price and seeks to find reasons for varying consumer behavior. This study was designed to examine how emotional-motivational factors, as indexed by electroencephalographic (EEG) asymmetry over the prefrontal cortex, predict purchase decisions for national brand and private-label products when their prices were above and below normal price. We also examined the factors influencing frontal EEG asymmetry. To our knowledge, this is the first study that looks at the role of approach-withdrawal motivation in the purchase situation.

Approach-withdrawal is a distinction used to explain and predict motivated behavior. Approach motivation is defined as the energization of behavior by, or the direction of behavior toward, positive stimuli, while withdrawal motivation is the energization of behavior by, or the direction of behavior away from, negative stimuli (Elliot, 2006).

Recent research in neuropsychology suggests that the left- and right-anterior brain regions are part of two separate neural systems underlying approach and withdrawal motivation, respectively (Davidson, 1995). Relatively greater left frontal activity indicates a propensity to approach or engage a stimulus, whereas relatively greater right frontal activity indicates a propensity to withdraw or disengage from stimulus (Coan & Allen, 2004).

The results showed that relatively greater left frontal activation during the pre-decision period (i.e., higher approach motivation when seeing and image of a product) predicted an affirmative purchase decision. The left frontal activation was more strongly related to an affirmative purchase decision when the price of a product was below normal price compared to when it was above the normal price. Furthermore, left frontal activation was more strongly associated with an affirmative purchase decision for brand products compared to private label products.

When we looked at the factors that influence frontal EEG asymmetry, we found that higher perceived need and quality were associated with greater

relative left frontal EEG activation. This finding is in line with the view that a consumer's motivation to purchase a product or service is triggered by an expectation that the object of purchase will satisfy his or her needs.

The results provide further evidence for the importance of emotional-motivational factors in purchase decisions. This study also supports the usefulness of EEG asymmetry index as a measure of approach-withdrawal motivation when studying purchase decisions.

## 5. SUMMARY AND CONCLUSIONS

This dissertation is based on four essays that study behavioral pricing. In the following, how the research problems and objectives were addressed in this study is summarized. Thereafter, the theoretical and managerial contributions of the research are discussed. Finally, the limitations of the research are considered, and potential future research ideas are suggested.

### 5.1 Summary of the findings

The first Essay reviews the research topics in behavioral pricing. The research concludes that the research in behavioral pricing has produced much important information and new insights in pricing. However, the total number of studies in behavioral pricing is relatively small and all subfields would benefit from additional research. The results of essay I were used to identify research possibilities in behavioral pricing. One of the most popular fields in behavioral pricing is research on reference price concept. However, the research on reference price is largely limited to studying grocery products by modeling scanner panel data.

Given the above, in the second Essay of this research, reference price and especially the consumer behavior when prices are above and below a reference price was the chosen theme. Essay II differs from previous research in that the object of the research is a service whose novelty is varied. In addition, we used choice-based conjoint method to assess changes in demand. The results highlight the fact that behavior around reference price may not only be loss aversive but also gain seeking and symmetric.

Essays III and IV study further the reference price concept. These two studies look at the roles of emotions and approach-withdrawal motivation when prices are varied from a reference price, using psychophysiological measures. The role of emotions has recently received increasing attention in consumer behavior research (e.g. Vohs et al. 2007); however, applications in pricing contexts are rare, as stated in the first Essay. To our knowledge, Essay IV is the first research that studies the approach-withdrawal motivation in a purchase situation.

The principal results are the following. Firstly, this dissertation highlights that the demand reactions to prices that are above and below a reference price are mixed. Essay II discusses services that are traditional and modern and Essays III and IV discuss private label and brand products. In terms of the number of times a product/service was purchased, private label and traditional services were more popular. This may be due to their lower prices and familiarity.

However, the more expensive products (brand product and modern service) induce stronger reaction in demand when prices are varied from the normal price. This confirms the finding presented in previous research that branded products and modern services might work better in promotions (Bronnenberg & Wathieu, 1996). This research also highlights that it is not only prices that are below normal price but also prices that are above normal price that have a larger effect on demand for branded products and modern services compared to private label products and traditional services. Thus, all price changes are more critical for brand products than for private label products.

When looking at private label and traditional services, the respondents showed loss aversive behavior, whereas for branded products and modern services the behavior was mainly gain seeking. This information is useful, for example, in planning price communication messages. For branded products and modern services it may be important that they clearly show to the consumer the gain acquired. Private label and traditional services seem to fulfill more basic needs.

In addition, emotional and motivational factors influence purchase decisions when prices are varied for branded and private label products. The role of emotions and motivation were looked at in two different studies. Positive emotions were found to predict affirmative purchase decisions. Moreover, price and brand directly influence purchase decisions. Low price level and private label products predict an affirmative purchase. However, price and brand also influence the elicitation of positive emotions. Low price levels induce more positive emotions than high price levels, and brand products more than private label products.

The results of approach-withdrawal motivation suggest similar findings. Increased approach motivation seems to be associated with affirmative purchase decisions. The approach motivation was more strongly related to an affirmative purchase decision when the price of a product was below normal price compared to when it was above the normal price. Furthermore, approach motivation was more strongly associated with an affirmative purchase decision for brand products compared to private label products. These results suggest that involvement of emotional and



motivational processes may be one explanation for varying behavior around a reference price.

## **5.2 Implications**

To my knowledge this dissertation is the first research that looks at the emotional and motivational responses that different price levels may trigger. The respondent behavior was studied by reference to prospect theory (Kahneman & Tversky, 1979), which suggests that people should be more responsive to losses (prices above a reference price) than to gains (prices below a reference price). However, our results suggest that people show loss aversive, gain seeking, and symmetric behavior in demand. The results of Essays III and IV indicate that the involvement of emotional and motivational factors may be one explanation for mixed consumer behavior. This in turn may indicate that loss aversion has an emotional and motivational component.

In addition, prices have both a direct role on purchase decisions as well as an influence on elicitation of emotions. In our research, low price levels have a positive influence on purchase decisions and on positive emotions. In addition, brand and emotions have a direct influence on purchase decisions, and brand also has an influence on the elicitation of emotions. However, private label products appear to predict affirmative purchase decisions, whereas branded products seem to trigger more positive emotions. Therefore, it is crucial that emotional and motivational factors are taken into account in purchase decision estimates. The ignorance of emotional and motivational factors may lead to incorrect conclusions.

In practice, this may suggest that price information should be presented in such a way that it translates into more positive or negative emotions. For example, price should represent the gains acquired or be presented in a format that triggers positive emotions. In marketing communication, a consistent message with the desired elicitation of emotions should strengthen the impact.

This dissertation also has a methodological contribution. The methods used in this research are numerous and some have not been previously used in a behavioral pricing context. For example, psychophysiological methods have turned out to be useful, for example, in communication and media research (Ravaja, 2004). This dissertation also shows that they provide a promising tool for pricing research. They provide important new information and empower researchers to study new dimensions of traditional pricing problems.

### **5.3 Limitations and future research**

The approach of this dissertation should be interpreted as exploratory. Since the research ideas and methods are relatively new in pricing contexts further research is needed to further assess the relationship between prices, brand, emotions, and motivations. In addition, the research employing psychophysiological measures is limited to studying purchases of grocery products in a laboratory setting. Research on wider variety of products and services in a field setting are needed in order to generalize the results.

However, the results suggest several avenues for further research. They show that emotional and motivational factors may be components of loss aversion. This is an interesting finding and calls for more research. Integration of emotions and motivation on decision-making research on loss aversion could, therefore, advance our understanding of loss aversion and reasons behind the phenomena.

Research on emotional and motivational factors in pricing contexts also seem very promising. Price information processing and the influence of emotions on different contexts should provide many interesting research topics; for example, emotions triggered by luxury products vs. consumables, risky products vs. safe products, hard decisions vs. easy decisions etc.

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## **Part II**

### **Original essays**



# Essay I

Somervuori Outi: Profiling behavioral pricing research in marketing.



# Profiling behavioral pricing research in marketing

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## Abstract

The purpose of this introduction is to conceptualize research on behavioral pricing based on previous literature. In addition, the study identifies main topics and discusses the evolution of the field. More specifically, the research examines 290 articles found in the ISI Web of Science database focusing on marketing journals that discuss behavioral pricing. The articles are reviewed using traditional literature review and research profiling methods. The main subfields in behavioral pricing identified in this study are: price-quality relationship, reference price, price awareness, measurement of willingness-to-pay (WTP), heuristics and biases, and context in pricing, price fairness, and price-ending. The notions of price-quality relationship and reference price are the most popular subfields studied in terms of number of articles published in marketing journals. In general, the behavioral pricing field is relatively new and all subfields would benefit from additional research. For behavioral pricing researchers, the study offers integrative insights into the field based on previous literature and identifies the main contribution and main topics discussed. The study also offers suggestions for new research ideas.

Key words: behavioral pricing, literature review, research profiling, bibliometrics, text-mining

# 1. INTRODUCTION

Traditional pricing research has its roots in economics, marketing, and accounting. This pricing review concentrates on pricing research in marketing and especially on consumer behavior in pricing; a topic called behavioral pricing. Behavioral pricing adds a psychological and behavioral perspective to pricing research and uses theories from social cognition and behavioral decision research.

Over the years, the content of pricing research in marketing has been reviewed by focusing on many different aspects in pricing: pricing strategy (Monroe & Della Bitta, 1978; Rao, 1984; Tellis, 1986), economics (Nagel, 1984), or influentiality of pricing research in marketing (Leone, Robinson, Bragge & Somervuori, 2011). Reviews on behavioral pricing have been conducted, albeit that some of them are relatively old (Gijsbrechts, 1993; Gourville, 1999; Monroe, 1973; Winer, 1988), or were specific to a certain field, e.g. hospitality management (Parsa & Njite, 2008).

However, there is still no clear understanding of what the core of behavioral pricing is. The main objective of this paper is to identify the concepts of behavioral pricing based on previous literature. To this end, this research structures behavioral pricing research, introduces the key findings, the main research areas, and the evolvement of the field.

To address these objectives this research uses traditional literature review and research profiling methods. First, a traditional literature review is carried out to characterize the main themes studied in behavioral pricing and to describe the key concepts of the field. Research profiling (Porter, Kongthon & Lu, 2002) is used to get the “big picture” of the literature. Research profiling is made possible through the use of modern search engines, electronic science databases, and sophisticated text mining tools. The idea behind research profiling is to review a topic at a larger scale. While the number of references in traditional literature reviews may be several hundred, their number in research profiling may be up to 20 000 (Porter & Cunningham, 2005).

This review consists of four main sections. Firstly, the research areas in behavioral pricing in previous literature are discussed. Secondly, the research methods of this research are described. Thirdly, the results are



presented in two parts; introduction to main themes studied in behavioral pricing, and the research profiling analyses of the whole data of behavioral pricing research. In the final section, the results are concluded and future research ideas discussed.

## 2. PREVIOUS REVIEWS

Since the term behavioral pricing is fairly new, no clear conceptualization of it exists. Miyazaki (2003, p 471) defines behavioral pricing<sup>1</sup> as: “Psychology of pricing constitutes an expansive subset of pricing research wherein prices and pricing are examined with respect to their human elements – that is, with respect to how humans attend to, perceive, process, and evaluate price information, as well as how they go about determining the price at which a particular item should be sold or purchased.”

Some previous review articles have reviewed behavioral pricing and pricing research in consumer marketing (Gijsbrechts, 1993; Gourville, 1999; Liu & Soman, 2008; Monroe, 1973; Parsa & Njite, 2008; Winer, 1988). These reviews have discussed topics as listed in Table 1.

Topics discussed in pricing reviews	Monroe 1973	Winer 1988	Gijsbrechts 1993	Gourville 1999	Parsa & Njite 2008	Liu & Soman 2008
Price/ perceived quality	x	x	x		x	
Reference price	x	x	x	x	x	x
Price memory/ knowledge	x		x			x
Price promotion			x			
Multiproduct pricing			x			
Dynamic pricing			x			
Measurement of willingness to pay (WTP)			x	x	x	
Heuristics and biases in pricing				x		x
Price fairness				x	x	
Price-endings	x				x	x
Context effects						x

Table 1. Summary of the topics reviewed in behavioral pricing review articles.

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<sup>1</sup> It seems that terms “behavioral pricing” and “psychology of pricing” are used synonymously. The term “behavioral pricing” is commonly used in marketing journals while “psychology of pricing” in psychology journals.

Most of the previous reviews appear to have concentrated on a few topics under the banner “behavioral pricing”. Only Gijsbrechts (1993) reviewed consumer pricing from a wider perspective. Some of the topics within Gijsbrechts’ (1993) article, however, are discussed more in relation to pricing strategy than consumer behavior. These topics are price promotion, multiproduct pricing, and dynamic pricing. These topics are vast themes in their own right and therefore left out of this review.

As a summary, the major themes in behavioral pricing, and as presented in Table 1, are: 1) Price/ perceived quality relationship, 2) Reference price concept, 3) Price awareness, 4) Measurement of willingness-to-pay WTP, 5) Heuristics and biases, and context in pricing, 6) Price Fairness, and 7) Price-endings. The research on contextual effects is included in section heuristics and biases in pricing. These topics are discussed in more detail within this review.

### **3. TRADITIONAL LITERATURE REVIEW AND RESEARCH PROFILING: DATA AND METHODS**

This review uses two methods: a traditional literature review and research profiling. The objectives of traditional literature reviews are to describe the key concepts of the field, review relevant prior literature, develop models to guide future research, present propositions, and provide concluding implications (Webster & Watson, 2002). A traditional literature review covers relevant literature on the topic in a narrow range and may concentrate, for example, on major contributions in leading journals.

In contrast, research profiling answers questions such as who, what, where and when (Porter et al., 2002; Porter & Cunningham, 2005). Who are the prolific authors? What are their specific research topics? Which institutions conduct research? What are the hot topics? When has research been conducted? How has it evolved over time? The answers are provided using simple frequency lists (e.g. top-25 lists), two-dimensional tables (e.g. key term counts by 3-year periods), and trend figures (e.g. the yearly number of publications). Moreover, text-mining tools make it possible to conduct advanced statistical analyses (correlation and cluster analyses) with textual data and to visualize results using multidimensional scaling. Such visual analyses can help understand, for example, which groups of concepts are used together to “enrich our understanding of a research milieu” (Porter et al., 2002). For this reason, research profiling may be used to augment traditional literature reviews. The approach uses modern search engines, electronic science databases, and sophisticated text mining tools to review a topic at a larger scale.

The key differences between traditional literature reviews and research profiling are summarized in Table 2.

Traditional literature review	Research profiling
Micro focus (paper by paper)	Macro focus (patterns in the literature as a body)
Narrow range (e.g. 20 to 200 references)	Wide range ( e.g. 20 – 20 000 references)
Tightly restricted to the topic	Encompassing the topic + related areas
Text discussion	Text, numerical, and graphical depiction

Table 2. Comparison: traditional literature review vs. research profiling (Porter et al., 2002)

The phases in the research profiling process are a) intelligence, b) analysis and design, and c) choice (Porter & Cunningham, 2005). Intelligence includes issue identification, selection of information sources, search refinement and data retrieval, and data cleaning. Analysis and design include basic and advanced analysis. Choice includes representation, interpretation, and utilization of the results. The intelligence and analyses presented in this research paper are discussed next.

### 3.1 Data

**Data source.** This review was conducted by examining publications found on the ISI Web of Science database. The ISI database was selected because it is one of the highest regarded science databases and is comprehensive in terms of the scholarly journals included. It is used extensively by academic researchers and by government agencies worldwide for the evaluation of national R&D performance. A search was carried out in January 2011 using the search terms “price” or “pricing” and limiting the search to scholarly articles. A total of 66 847 publications were identified in different disciplines.

**Article selection.** As a second step, the search was refined to include articles only from 20 of the principal marketing and business journals (see the list of selected journals in Appendix 1). All of the general marketing journals included in ISI Web of Science that had more than ten pricing articles were selected in the review. In addition, articles from the academic publication *Journal of Product and Brand Management* were included because the journal is the only marketing journal that concentrates on pricing. Further, four more general business journals were included because they publish many pricing articles from a marketing point of view. These journals are, *Harvard Business Review*, *Journal of Business Research*, *Journal of Business*, and *MIT Sloan Management Review*. The articles identified in these journals were reviewed so as to include only

marketing related pricing publications. The total number of pricing articles in these 20 marketing journals was 2 308.

In the third stage, all of the 2 308 pricing articles were manually scoped to select articles that discuss behavioral pricing. All articles that discussed the themes identified in section two within their title, keywords, or abstract were included. The articles that were excluded from further processing discussed topics such as pricing strategy and tactics, price competition, industrial or b-to-b pricing, and studies that primarily concerned other marketing applications. The selected themes in behavioral pricing were the price-quality relationship, reference price, price awareness, willingness-to-pay, heuristics and biases in pricing, price fairness, and price-endings. Some other behavioral themes were identified in the scoping, such as emotions, trust, motivation, purchase behavior, and culture. If these studies primarily studied pricing, they were included in the subcategory “other”. The final number of articles included in the analysis was 290. Due to the selection process applied, this study may not include all published articles that discuss behavioral pricing, however, as the aim of the research is to study the main contents of the field and not carry out a census, a dataset that includes most of the published articles is sufficient even though it might not include them all.

In this study, the objective of the traditional literature review is to describe the key concepts of the field. Therefore, the review concentrates only on a few major contributions in each theme. All 290 articles were included in the profiling analysis.

**Data cleaning.** After the final data set was selected all data were cleaned. The purpose of data cleaning or term stemming is to identify items that may be equivalent and thus duplicated; for example Monroe K and Monroe Kent. In addition, the clean-up process aims to catch plurals and misspellings.

Content of the articles can be studied using information found in the title, keywords, and abstract. However, not all information can be found for all articles, for example, keywords are published in ISI WoS only in articles published after 1990. Therefore, we chose to use each of these three fields because at least one is available for all of the articles. For this purpose the title and abstract fields were further processed. First, the titles and abstract texts were separated into discrete words and phrases using Natural Language Processing (NLP). Second, “stop words” such as “and”, “the” were removed. Third, trivial English and research related words such as “author”, “research” were removed. Then the title words, the abstract words and the author provided key words were combined into one field. This field

was cleaned for term stemming, for example we combined words “segment”, “segments” and “segmentation” as “segmentation”. In the final dataset, we also eliminated the original search terms “price” and “pricing”, as they were present in all articles. In addition, the general behavioral pricing terms “consumer”, “market” and “category” were removed. In the text that follows, this combined data set is described as “key terms”. Note that one term found in one document is counted only once even though the same term might appear in title, abstract, and key words.

### 3.2 Analyses

In results section, all behavioral pricing topics are first briefly introduced by reviewing the relevant research conducted under the theme. Thereafter, the main terms discussed in each area are identified and presented as cluster maps. The software used, VantagePoint, permits advanced analyses such as cluster maps using Aduna software (VantagePoint, 2011; Aduna Softwares, 2011). The main purpose of cluster maps is to show which key terms appear in the same articles.

The subsequent research profiling analyses include basic listings of number of articles by author, institution, and journal. In addition, cross-tables are used to identify trends in time. In this study we also used auto-correlation matrices to characterize the field and auto-correlation maps to visualize the linkages between the key terms. The auto-correlation matrix<sup>2</sup> is calculated using a co-occurrence matrix in which articles are rows and key terms are columns. The numbers in this co-occurrence matrix are either 1 or 0; 1 referring to the fact that the key term appears in the article, and 0 if it is absent. Thereafter, the Pearson’s correlation coefficient ( $r$ ) is calculated to measure the co-occurrence of any two key terms being used in the same record. For example, an auto-correlation matrix of key terms will indicate key terms that are often used together.

The auto-correlations are visualized in a map produced through multidimensional scaling (MDS), a figure called an auto-correlation map. The maps are produced applying MDS to the auto-correlation matrix. The MDS algorithm simply reduces an N-dimensional representation to two dimensions; thereby seeking to maintain key terms with high correlation in close proximity to each other. The x- and y-axes of the maps have no specific meaning. Generally speaking, key terms that are close to each other

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<sup>2</sup> In statistics auto-correlation is used in a different sense.

are more similar than those that are farther away. However, the presence or absence of a line (and the thickness of the line) between any two key terms are more appropriate measures of proximity, because it implies a relatively high correlation between them. We clarify with an example. Assume that key terms A and C are highly correlated and also A and B. In this case A and B and A and C appear close in the maps and have a link between them; however, B and C must also appear relatively close to each other, since they are both close to A, despite having a weaker link between them. The size of the nodes represents the number of articles where the key term is included.



## 4. REVIEW OF KEY RESEARCH AREAS

The following section introduces each of the research topics in behavioral pricing. First the previous literature in the subcategory is discussed, and second the key terms used are identified. A cluster map is presented for each subcategory that shows the relative frequency of key terms and how the terms are related to each other.

### 4.1 Price-Quality Relationship

Many studies have researched the relationship between price and quality. When suggesting that people may judge quality by price, Scitovsky (1945) pointed out that such behavior is not irrational. It simply reflects a belief that the forces of supply and demand would lead to a “natural” ordering of products on a price scale, leading to strong positive relationship between price and product quality.

This extant research has discussed the objective relationship between price and quality levels, and the perceived association between these constructs. However, the consensus on the relationship’s magnitude, generalizability, or statistical significance in both research streams is weak. The conclusion is that there seems to be a positive relationship between actual quality and price (Tellis & Wernerfelt, 1987) and between perceived quality and price (Monroe & Dodds, 1988; Völckner & Hofmann, 2007). However, the research has been criticized for methodological weaknesses and weak underlying theoretical explanation (Monroe & Dodds, 1988; Olson, 1977; Rao & Monroe, 1989).

Objective quality refers to measurable and verifiable superiority of some predetermined ideal standard or standards, e.g. published quality ratings. Many researchers have studied whether objectively better quality products are more expensive than lower quality products. On average, the price quality relationship seems to be positive, but relatively weak (Tellis & Wernerfelt, 1987). However, researchers debate the existence of objective

quality, some claim that objective quality does not exist; that all quality evaluations are subjective (Zeithaml, 1988).

Perceived quality (subjective quality) is defined as the consumer's judgment of product superiority or excellence (Zeithaml, 1988). The model in Figure 1 presents the role of price on consumers' perception of quality, sacrifice, value, and willingness to buy (Monroe, 2003).

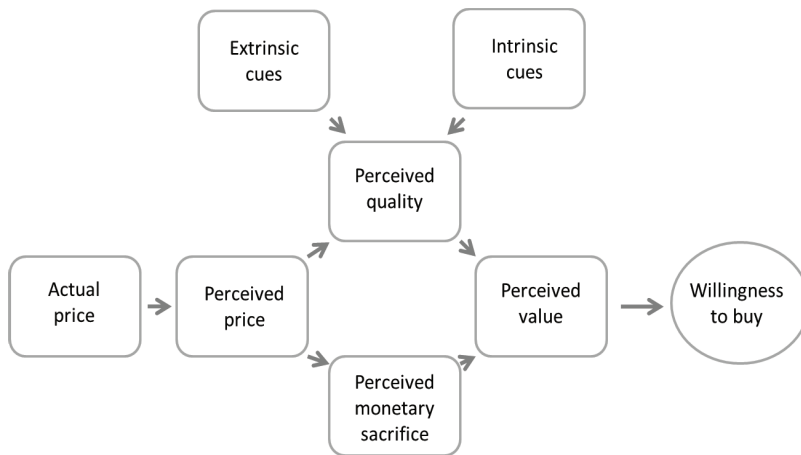


Figure 1. Price-perceived quality value model (Monroe, 2003).

According to this model price may in part be used to infer product or service quality and perceived monetary sacrifice. The significant price factor here is the perceived price rather than the actual price. The perception of price is influenced by perceived differences between offered price and reference price, and the representation of price (these themes are discussed in the following sections in more detail).

In a meta-analysis, Völckner and Hofmann (2007) analyzed price-perceived quality studies published between 1989 and 2006, and found an average correlation of .273 between price and perceived-quality (high price being an indicator of high quality). The dimensions of perceived quality are, for example in the case of durable goods, ease of use, versatility, durability, serviceability, performance, and prestige (Brucks, Zeithaml & Naylor, 2000). In their experiment Brucks et al. (2000) found that participants used price and brand name much more frequently when evaluating prestige than when evaluating any other quality dimension.

The extent to which the price impacts perceived quality is influenced by the nature and availability of other product information. Perceived quality is influenced in general by extrinsic and intrinsic cues. Extrinsic cues are external product related attributes such as price, brand and packaging and intrinsic cues are inherent product attributes such as nutrition value. Rao

and Monroe (1989) concluded that according to their meta-analysis of previous research the relationship between price and perceived quality and brand name and perceived quality were positive and statistically significant. Richardson, Dick & Jain (1994) found that grocery items are evaluated primarily by the extrinsic cues rather than by their intrinsic characteristics. In addition, the consistency of multiple cues influences the evaluation. If there are two quality cues, the quality ratings are good if both cues present positive quality inferences. However, if either cue signals low quality, overall evaluations are reduced (Miyazaki, Grewal & Goodstein, 2005).

Also consumer familiarity with the product or service mediates the effect of other cues (Olson, 1977; Monroe, 2003). As consumers become familiar with a product they are more likely to use intrinsic cues rather than price or other extrinsic cues as indicators of product quality. However, highly familiar consumers (experts) use either price or intrinsic cues as indicator of quality, depending on their knowledge of price as a good or bad indicator of product quality (Monroe, 2003).

In the model, the perceived value is a trade-off between consumers' perception of quality and sacrifice and is positive when perceived quality is greater than perceived sacrifice. The model posits a positive relationship between price and perceived quality, and price and perceived sacrifice. Willingness to buy is positively related to perceived value.

The key terms studied in price-quality research are presented in the following cluster map. The map shows how the top 15 key terms relate to each other. Each key term is presented as a different network. The name of the key term is presented in the center of each network. Each node in the map represents a published research article. Each node in the map shows the key terms associated with that article. For example, the group of articles that include term "quality" (A) does not contain any other top 15 key terms other than quality, whereas the article represented by B includes key terms quality, perception, purchase, and choice.

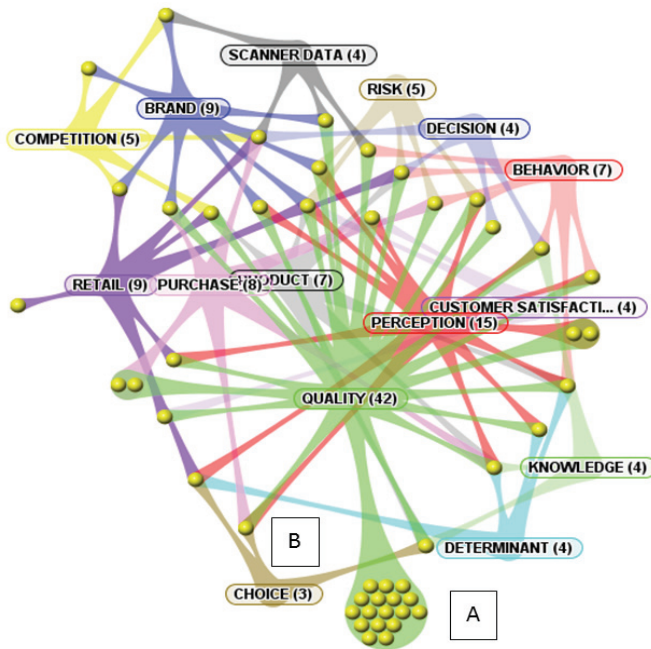


Figure 2. Cluster map of key terms used in price-quality research

The key terms that are often associated with price-quality research are quality, perception, customer satisfaction, product, retail, brand, and purchase. The other key terms are associated more randomly in the examined price-quality articles. A large percentage of the studies examine the existence and magnitude of price and either objective or perceived quality relationship. The objective price-quality studies often statistically test the correlation between price and quality information as published in expert reports e.g. Consumer Union's Consumer Report. The studies on perceived quality typically collect experimental evidence of the relationship between price and perceived-quality. According to the top key term listing, research on perceived quality has received more attention. Much of that research has studied the consumer purchase situation in the retail environment. The influence of other cues such as product, brand, and customer satisfaction on quality perception has also been included in the same studies. Therefore, the terms identified in top key terms seem natural.

A few integrative studies (Monroe & Dodds, 1988; Rao & Monroe, 1989; Zeithaml, 1988) have tried to establish a common framework of the elements and relations of the conceptual and substantive domains. The frameworks have been highly influential but the empirical evidence of causal relationships and their boundaries are still today somewhat elusive. As Monroe and Dodds (1988) argued, a series of replicative studies should

be conducted to fully understand the robustness of the price and perceived-quality relationship.

## **4.2 Reference Price**

Reference price (Monroe, 1973) is the price consumers use to compare the offered prices of a product or service. It means that consumers do not respond to prices absolutely, instead relative to reference price. Such comparison defines whether the offered price is perceived low or high (Della Bitta, Monroe & McGinnis, 1981). The reference price concept has been accepted as an empirical generalization in marketing (Kalyanaram & Winer, 1995).

### **4.2.1 Theoretical bases for reference prices**

Researchers have adopted theoretical perspectives from psychology and behavioral economics to study how consumers construct and use reference prices. One of the first theories discussed (Monroe, 1973) was adaptation level theory (Helson, 1964), that was later augmented by range theory (Volkman, 1951) and range-frequency theory (Parducci, 1965). The other theories discussed are the Weber-Fechner Law (see e.g. Monroe, 1971), assimilation-contrast theory (Sherif & Hovland, 1961) and prospect theory (Kahneman & Tversky, 1979).

#### *Adaptation-level theory augmented with the range and range frequency theories*

Adaptation-level theory (Helson, 1964) is originally a sensory theory. According to it, stimulus values are judged against recent sensory experiences. This means that past and present experiences define an adaptation level, a reference point, relative to which new stimuli are perceived and compared. In behavioral pricing context, this would mean that consumers compare prices against recent price experiences. Three cues influence individuals' adaptation: focal, contextual and organic cues (Della Bitta & Monroe, 1974). Focal cues are the stimuli an individual is directly responding to, e.g., price. Available monetary resources, purpose of purchase, and the purchase environment including other offers are contextual stimuli. Organic cues refer to inner physiological and psychological processes affecting behavior (Della Bitta & Monroe, 1974).

Another theory of how people make sensory judgments is range theory (Volkman, 1951). Range theory is based on the range principle of judgment in which endpoints of the range of stimulus values are used as anchors for judgment. In behavioral pricing context, consumers would compare prices against the two prices that define the minimum and maximum in the contextual set. In other words, people use range of remembered price experiences or actual prices in the evaluation context to set a lower and upper bound of price expectations. Range frequency theory (Parducci, 1965) asserts that the judged value of a stimulus is determined by its location within the distribution of contextual stimuli that are brought to mind at the time of judgment. The “range principle” defines the most extreme values of the relevant context and the “frequency principle” describes the weight of different locations. While the range theory considers only the extreme values of the range, the range frequency theory uses all values in the range.

#### *The Weber-Fechner Law*

The Weber-Fechner law from psychology attempts to describe the relationship between the magnitude and the perceived intensity of the stimulus (Monroe, 1971). Weber (1795-1878) found out that the rate of change is proportional to the original value  $\Delta S / S = K$ , where  $S$ =stimulus and  $K$ = response. In pricing context this would mean that perceived price difference is proportional to reference price, for example 20 € change matters more on a 100 € item than on a 1 000 € item. Later Fechner (1801-1887) adapted Weber’s law by noting that the relationship between the change and the response is logarithmic,  $R = k \log S$ . Where  $R$  is the sensation derived from changes in the stimulus  $S$  (see Monroe, 1971 for a complete derivation). In pricing context, if price is stimulus and quantity purchased is the response, the theory would suggest a logarithmic relationship between the two constructs.

#### *Assimilation-contrast theory*

Assimilation-contrast theory is grounded in social-judgment theory by Sherif and Hovland (1961). It is a theory of attitude change that suggests that consumers are likely to accept only moderate attitude changes. The theory assumes that an individual compares a new stimulus against a background of previous experiences within category. If the change

suggested is too extreme, the contrast with presently held attitudes would cause rejection.

### *Prospect theory*

Prospect theory developed by Kahneman and Tversky (1979) models decision-making under risk. The key points of prospect theory are, first, that the value function is defined over gains and losses, not in absolute amounts. There is assumed to be a reference point against which stimuli are compared and regarded either as gains or losses. Second, the function is concave for gains implying risk aversion and convex for losses implying risk seeking. The function is steeper for losses than for gains, suggesting that individuals are more responsive to losses than to gains. This phenomenon is called loss aversion. In pricing context, negative differences between the reference price and the evaluated price are considered gains and positive differences losses, respectively. The key behavioural implication is the assumption that individuals would react to losses more strongly than to gains.

### *Integration of the theories*

A combined theory would have the following features in pricing context. First, individuals use a standard (reference price) to compare the offered price of a product or service. This conclusion is in accordance with adaptation-level theory, assimilation-contrast theory and prospect theory. The range and range frequency theories augment the conceptualization of reference price, concluding that the reference price is rather a range of prices than a specific price. Second, the cues that influence the reference prices according to adaptation-level theory are: focal, contextual and organic. The range of reference prices is continuously changing as new cues are encountered. Third, there is a region around reference price such that changes in price within this region produce no change in perception. This region is called the latitude of acceptance or acceptable price range. This is in accordance with the assimilation-contrast theory and the Weber-Fechner Law. Fourth, the perceived price difference is proportional to reference price. The phenomenon is often called “money illusion” (Shafir, Diamond & Tversky, 1997). Also this conclusion is in agreement with e.g. the Weber-Fechner Law. Fifth, according to prospect theory, negative differences between the reference price and the evaluated price are considered gains and positive differences losses, respectively. Individuals’ value function to

gains (prices that are above reference price) is convex and to losses (prices that are below reference price) concave, suggesting S-shaped value function over gains and losses. Sixth, the reaction to losses is steeper than to gains, a phenomenon called asymmetric reference price effect and loss aversion.

#### **4.2.2 Empirical evidence from reference price research**

The reference price concept has been an active area of research. Many of the above features have been tested empirically by two fairly independent research streams. One of the research streams studies the reference price using an experimental approach and other uses econometric analyses of scanner panel data (Mazumdar, Raj, & Sinha, 2005). The results of these empirical studies are discussed next.

##### *The use of reference prices*

All the studies on the reference price research agree that individuals use a standard (reference price) to which they compare the offered price (Mazumdar et al., 2005). Rajendran and Tellis (1994) conclude that ignorance of the reference price in pricing decisions may lead to suboptimal prices.

Niedrich, Sharma and Wedell (2001) suggest that the reference price is rather a range than a mean (or expected value). They found out that consumers have a sense of the range of reference prices and also relative frequencies of prices they have encountered.

##### *Formation of reference prices*

The cues that influence the internal reference price according to adaptation-level theory are focal, contextual, or organic (Della Bitta & Monroe, 1974; Della Bitta, Monroe & McGinnis, 1981). Focal cues are the immediate focus of attention, e.g., a price under consideration. Contextual or background cues are all other stimuli in the situation providing the context within which the focal cues are operative. Organic cues refer to inner physiological and psychological processes affecting behavior (Monroe, 2003).

The contextual cues that influence the formation of internal reference price have been extensively studied. Most of the econometric analysis of scanner panel data measure reference price primarily as some average of past prices. However, most of them do not study directly the importance of



alternative cues for reference price. Rajendran & Tellis (1994) specifically tested the role of 1) other products' prices in the product category and 2) prices encountered on past purchase occasions with a brand choice model of scanner panel data. They found out that both are significant predictors of consumer choice. Other products' prices in the product category are at least as important as the prices faced on past purchase occasions, but they are stronger when brand preference is weak, brand sampling is wide, and shopping is infrequent. Furthermore, the low price brand tested was the most important measure of the other products' prices. A moving average of past prices of each brand tested was the most important measure for prices encountered on past purchase occasions. In addition, number of promotions among previous purchases influence the reference price. Since consumers encounter frequently low prices for frequently promoted products, the internal reference price also becomes lower than for products that are not frequently promoted (Kalwani, Yim, Rinne & Sugita, 1990).

Della Bitta, Monroe and McGinnis (1981) argue, based on their experiments, that also the advertised selling price and the advertised reference price influence internal reference price. A comparative price advertisement is a seller's attempt to impose a high reference price to consumer and compare it against the advertised price. Also the type of shopping trip (Bucklin & Lattin, 1991), store environment (e.g. Alba, Mela, Shimp & Urbany, 1999; Biswas and Blair, 1991; Thaler, 1985), product category (Mazumdar et al., 2005), advertising, mental representation of a price, and consumer characteristics influence the formation of the reference price (for a review see, e.g., Mazumdar et al., 2005; Parsa & Njite, 2008).

A few studies seek to understand the influence of organic cues on internal reference price. Adaval & Monroe (2002) suggest that an important issue underlying the formation of reference prices is the role of automatic or non-conscious information processing relative to deliberative or conscious information processing. They conclude that the references that people use when evaluating products can be formed unintentionally and may be influenced by exposure to stimuli of which they are not consciously aware. Therefore it is important to distinguish that when evaluating a price, individuals may be aware that they judge the price relative to a reference. However, they may be unaware of the factors that have led to the formation of the reference price. Also Thomas and Menon (2007) studied the influence of organic cues. They found out that customers with low repetition-induced confidence have a higher internal reference price than more confident customers.

### *Price thresholds or latitude of acceptance*

The price thresholds identify different regimes associated with price range; also called latitude of acceptance (LPA) or acceptable price range. This concept suggests that consumers have a lower and upper price threshold (Monroe, 2003).

The widths of the latitude of price acceptance depend on the reference price level, product familiarity and brand loyalty (Kalyanaram & Little, 1994). The consumers with a higher average reference price level demonstrate wider latitude of price acceptance, while the more familiar consumers (with higher purchase frequency) have narrower range of acceptable prices. Kalyanaram & Little (1994) conclude that increased expertise allows the consumers with greater ability to identify prices at finer level, leading to narrower price ranges for highly knowledgeable customers. In addition, loyal customers (since they are loyal) have a wider latitude of acceptance and demonstrate greater tolerance of price fluctuations.

### *Money illusion*

In economics it is assumed that the value of money is invariant, e.g. 10€ in one transaction is worth the same as 10€ in another transaction. However, in pricing context the price differences are valued relative to reference price and as the Weber-Fechner Law indicates the perception of price difference depends on the magnitude of change (Monroe, 1971). For example, Thaler (1980) showed in an experiment that people considered 10\$ saving on 29\$ item worth travelling to second store, but not when 10\$ saving concerned 495\$ item. From an economic perspective, if an individual decides to travel to a second store to save 10\$ in the first scenario, the same individual should want to travel to a second store to save 10\$ in the second scenario too. In both scenarios, the tradeoff is 10\$ for 10 minutes of individual's time. Money illusion arises in large part because it is considerably easier and more natural to think in relative rather than in absolute terms (Shafir et al., 1997).

### *S-shaped value function over gains and losses*

Prospect theory suggests that the individuals' value function is typically concave for gains implying risk aversion and convex for losses implying gain seeking behavior towards losses (Kahneman & Tversky, 1979). This

assumption has been tested in risky decision-making situations (Tvesky & Kahneman, 1991). However, in pricing context the shape of the value function from reference price is less studied.

#### *Asymmetric reference price effect and loss aversion*

Several studies have looked at the asymmetric reference price effect and loss aversion. However, empirical results are mixed; some concluding that consumers are more responsive to losses, others that consumers are more responsive to gains, while some report symmetric behavior. Most of the research in this area statistically model consumer panel data (e.g. Bell & Lattin, 1998; Hardie, Johnson, & Fader, 1993; Kallio & Halme, 2009; Krishnamurthi, Mazumdar & Raj, 1992; Mazumdar & Papatla, 1995; Putler, 1992), and frequently use purchased grocery products as an example.

Some studies have tried to identify characteristics that will lead to loss averse or gain seeking behavior. Krishnamurthi et al. (1992) concluded that loyal customers show symmetric behavior towards losses and gains, whereas non-loyal customers show strong asymmetry. However, non-loyal customers are more responsive to gains than to losses. The researchers suspect that the reason is that non-loyals are bargain-hunters and more price sensitive than loyal customers. Han, Gupta and Lehmann (2001) identified that price sensitive households have small thresholds for losses and gains. Households in the price sensitive segment in their study are also deal-prone and non-loyal.

Klapper, Ebling and Temme (2005) argue that quality consciousness strongly affects loss aversion; non-quality conscious consumers show loss aversion, in contrast to quality conscious consumers who show less loss aversion. Furthermore, related to quality consciousness, some studies claim that product quality-tier influences the behavior (Hankuk & Aggarwal, 2003). In different product categories, consumers behave differently in their choices around reference price. For example, Mazumdar and Papatla (1995) showed that margarine shoppers were more responsive to gains, and liquid detergent shoppers more responsive to losses. Mazumdar and Papatla (1995) suspect that the reason is in differences in promotional levels. The level of promotion is much higher in liquid detergent than in margarine and thus, consumers may exhibit stronger response to promotions and greater aversion to paying regular prices. This finding may also imply that the reference price is lower for frequently promoted products than for not frequently promoted products, supporting the conclusion by Kalawani et al. (1990) that the number of promotions among

previous purchases influences the reference price (see section on formation of reference prices).

#### 4.2.3 Key terms studied

The top key terms studied in reference price research are presented in Figure 3. The mapping shows how the top 15 key terms are related to each other.

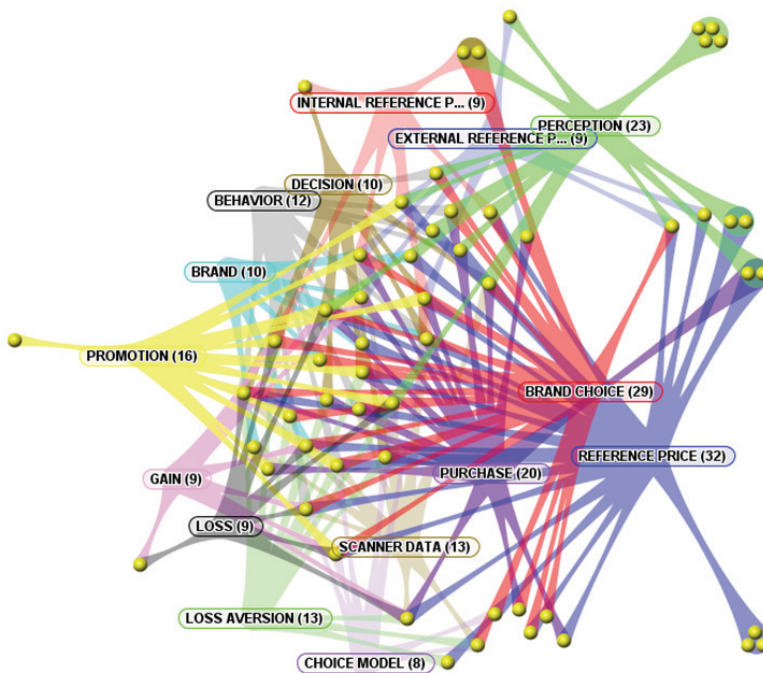


Figure 3. Cluster map of key terms used in reference price research.

According to key terms the most studied areas on reference price research are the formation of reference price and asymmetric reference price effects. The terms internal reference price, external reference price and perception are often used in articles studying the formation of reference prices. While the terms brand choice, scanner data, choice model, loss aversion, gain and loss refer to studies on asymmetric reference price effects and loss aversion.

The experimental research stream has been especially influential on the reference price formation research. Even though some econometric studies consider the formation of reference price indirectly, only a few of them explicitly test the influence of different cues of reference price formation (Rajendran & Tellis, 1994). These studies suggest that contextual cues are important in the formation of reference price. The contextual cues may be

other products' prices in the product category, prices faced on past purchase occasions, advertised price and advertised reference price (Della Bitta, Monroe & McGinnis, 1982; Rajendran & Tellis, 1994). The influence of organic cues on reference price formation has been significantly less studied. However, the few novel studies (e.g. Adaval & Monroe, 2002; Thomas & Menon, 2007) suggest it to be a promising new research area.

Asymmetric reference price effects and loss aversion have been mainly studied by econometrically modeling scanner panel data. The results are mixed; some identifying support for loss aversion, while others find symmetric or gain seeking behavior (e.g., Bell & Lattin, 1998; Hardie et al., 1993; Krishnamurthi et al., 1992; Mazumdar & Papatla, 1995; Putler, 1992). However, the mixed results may also be due to varying properties included in the choice model (Rajendran & Tellis, 1994; Terui & Dahana, 2006). Furthermore, the studies generally model loss aversion in terms of value.

The other features of the combined theory (price thresholds, money illusion and S-shaped value function) are less studied in marketing. Money illusion, for example, has been actively studied in economics (Fehr & Tyran, 2001; Sharif et al., 1997), but less in marketing. To our knowledge the shape of the value or demand function from the reference point has not been studied in pricing context.

### **4.3 Price Awareness**

Traditional pricing research assumes that consumers know the prices they pay and that price is an important element of the purchase decision. However, much research on price awareness suggests that consumer recall of prices is poorer than expected. In a meta-analysis, Estelami and Lehman (2001) examined previous work on price recall. They estimate that the percentage of customers who can exactly recall specific product prices ranges from 5 to 50 %. Consumers' price knowledge is tied to, e.g., product category and purchase frequency (Estelami & DeMaeyer, 2004), consumers' general knowledge of that product (Lawson & Bhagat, 2002), and consumers' knowledge of future deals (Krishna, 1994). Aalto-Setälä and Rajjas (2003) suggest that at least part of the weakness in consumer price recall may be explained by variation in market prices.

Other studies have found some evidence that number processing difficulty and conscious/ unconscious price information processing influence the accuracy of price estimation (Luna & Kim, 2009; Monroe, 2003; Monroe & Lee, 1999; Vanhuele, Laurent & Dreze, 2006; Vanhuele & Dreze, 2002).

Numbers are cognitively processed in three different ways (Dehaene, 1992; Monroe, 2003). The first process is number transcoding that refers to the ability to mentally manipulate sequences of symbols according to certain rules, e.g. calculating the difference between offered price and a reference price. The second process involves quantification; that is, the process of counting, subitizing, and estimating. The third process involves approximation and processing of quantities. It refers to the process in which numbers are converted into internal magnitude representations. The conversion is automatic and very fast. In pricing context, for example, a price 9,50 may be interpreted as cheap or good deal depending on the context. A few studies have empirically looked at number processing in the pricing context and they conclude that number processing influences the accuracy of price recall ; for example, as the number of digits increases, the more difficult the number is to remember (Luna & Kim, 2009; Vanhuele et al., 2006).

Monroe and Lee (1999) suggest that the reason for poor price information recall may be that individuals often store price information in implicit memory. Theories of memory from psychology suggest that previously encountered information is stored either in explicit or implicit memory. Explicit memory is consciously recollected, while implicit memory is stored unconsciously from encountered stimuli. Conscious price information processing occurs in situations with active price search. If consumers perceive price information as self-relevant, they engage in conscious price information processing and a magnitude representation of a price and the evaluative judgment may transfer from working memory into long-term memory. In this situation, the consumer would be more likely to recall the price later (Monroe, Powell & Choudhury, 1986).

Alternatively, only the evaluative judgment, not the actual price information, is transferred into long-term memory. This would lead to poor price recall, but the consumer may still be able to indicate whether the price is cheap or expensive.

Even when prices are perceived as irrelevant they still may be processed unconsciously, though these price stimuli get registered only peripherally and leave weak traces in explicit memory that cannot be recalled even immediately after product choice (Monroe & Lee, 1999). However, the consumer may still be able to indicate the goodness of the deal as in the previous situation.

Vanhuele and Dreze (2002) tested the role of explicit and implicit memory empirically and concluded that prices may often not be accessible to recall but show up in deal recognition. This means that consumers do not really know the exact product prices, and they cannot tell whether a price is

exactly the one they are used to. They can, however, recognize a good deal or a bad deal when they see one.

Figure 3 presents the top key terms used in price awareness research and how the terms are related to each other. The top key terms naturally include terms that describe the topic: knowledge, memory, and recall. Also included are issues such as store, brand, purchase, and shopper. These terms indicate that a popular application area is consumer purchase in grocery stores. Consumer characteristics, price consciousness, and expertise are also often studied topics found in the price memory discussion. It seems that majority of the studies have tested the price awareness with different methods. Only a few novel studies have tried to understand the processes underlying price awareness.

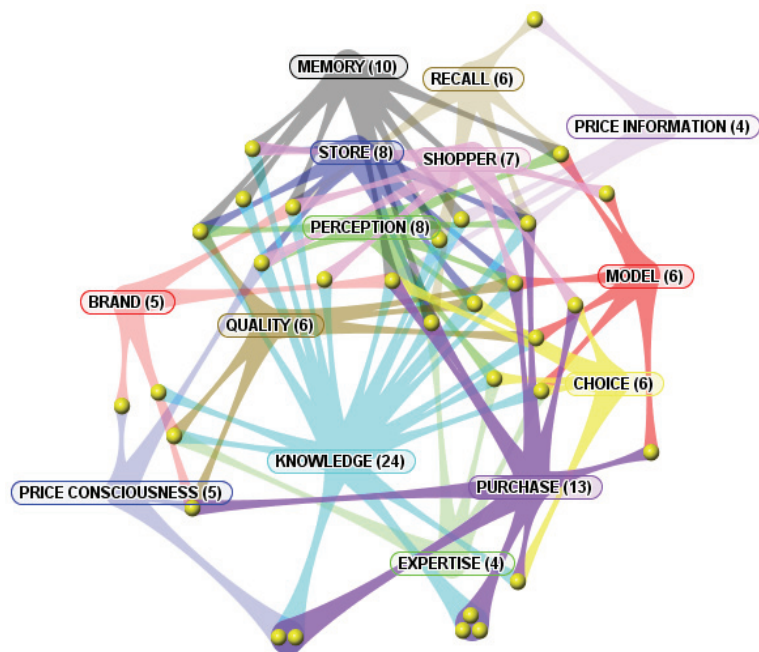


Figure 4. Cluster map of key terms used in price awareness research.

#### 4.4 Estimation of Willingness-To-Pay (WTP)

Estimation of a consumer's willingness to pay (WTP) is needed to set the product prices at a right level, in developing new products, and in formulating competitive strategies, (Miller, Hofstetter, Krohmer, & Zhang, 2011; Wertenbroch & Skiera, 2002). Much discussion around willingness to pay is concentrated on testing different methods to assess willingness to

pay (Ajzen & Driver 1992, Völckner, 2006) or to compare the methods (Wertenbroch & Skiera 2002, Miller et al. 2011).

#### 4.4.1 Different methods used to estimate willingness-to-pay

The methods are typically distinct whether they measure willingness to pay directly or indirectly, or whether they measure hypothetical willingness to pay or actual willingness to pay. Commonly used methods to measure willingness to pay are presented in Table 3 and they are briefly explained below.

Context/ measurement	Direct	Indirect
<b>Hypothetical WTP</b>	-Question format	-Choice-based-conjoint (CBC)
<b>Actual WTP</b>	-Becker, DeGroot, and Marschak's mechanism (BDM) -Vickery auctions	-Scanner data -Test market data -incentive based choice-based-conjoint (incentive aligned CBC)

Table 3. Methods to estimate willingness-to-pay .

#### *Question format – open ended or closed ended*

Respondents may be asked to evaluate their willingness to pay in a survey. The question type may be open-ended or close-ended. In the open-ended format the idea is that the format of the response is free. In closed-ended questions the respondents are typically asked whether they would be willing to buy a product at a given price.

The benefit of question format is that it can be used for a large variety of concepts and products. However, the previous research has found out that the estimation may be inaccurate and the questions may also be subject to framing effects (Wertenbroch & Skiera, 2002).

#### *Choice-based conjoint analysis (CBC)*

Conjoint analysis is a statistical method to estimate how people value different product/ service features. In a conjoint questionnaire a product or service is described as attributes and price may be one of the attributes. For



example, for a memory stick the types of attributes could be brand, amount of memory, and price. Each attribute can be broken down to many levels, e.g., levels of memory could be 2 GB, 4 GB, 8 GB or 16 GB. The respondents are asked to evaluate the value of different attribute levels. In choice-based conjoint (CBC) the respondents are presented a set of concepts of which they are asked to choose the best alternative (Sawtooth software, 2012). Choosing a product from a group of products is assumed to simulate a normal shopping situation. In randomized choice-based conjoint designs, each attribute level is equally likely to occur with each level of every other attribute. Therefore, the impact of each level can be assessed by counting the proportion of times concepts including that level are chosen (Sawtooth software, 2012). This allows detailed analysis of price and demand.

#### *Incentive-aligned choice-based conjoint (incentive aligned CBC)*

Traditional choice-based conjoint deals with a hypothetical situation, and research has shown that a hypothetical situation does not motivate the participants to reveal their true preferences. To overcome this problem Ding, Grewal and Liechty (2005) suggest including an incentive to choice-based conjoint. Incentive aligned choice-based conjoint works the same way as traditional choice-based conjoint, however, after the respondent has completed all the conjoint tasks, one task is randomly selected to count for real. The respondent has to buy the selected option unless the selected option is the option not to purchase any.

#### *Becker, DeGroot, and Marschak's mechanism (BDM)*

BDM is a widely used method for estimating the willingness to pay. The idea is that first, the respondent is asked to make a price offer for a product. The offer should equal the highest willingness to pay of the product. Second, a price for the product is randomly assigned, e.g., the respondent draws a ticket from an urn. If the randomly selected price is lower or equal to the offer, the respondents have to buy the product. If the randomly selected price is higher than the offer, the respondents are not allowed to buy the product. According to Wertenbroch and Skiera (2002), the method is theoretically incentive compatible, realistic, transparent to respondents, and operationally efficient.

### *Vickery auctions*

Hoffman, Menkhaus, Chakravarti, Field and Whipple (1993) introduced Vickery auctions or second price, sealed bid auctions to the marketing community. In a Vickery auction, the respondents are asked to make a sealed bid for a product under auction. The highest bidder buys the product at the price of the second highest bid. This mechanism is said to provide the bidders an incentive to reveal their true willingness to pay (Sichtmann & Stingel, 2007). However, it has some practical and empirical limitations related to the fact that the auction has to be arranged in a laboratory and the auction mechanism does not simulate normal buying situation (Wertenbroch & Skiera, 2002).

### *Scanner panel data*

Scanner panel data is retail purchase data (brand, product, price, amount purchased) collected from members in a panel. Panel members are individuals or households that scan their daily purchases with an electronic device that stores that data. Scanner data is useful as it observes actual purchases in a real environment.

### *Test market data*

Test market data aims to simulate a normal purchase situation; e.g., a small scale product launch to test consumer reactions. For example, laboratory experiments where the participants' task is to choose either to purchase or not to purchase a product offered them.

#### **4.4.2 Comparison of different methods**

In general, the research has concluded that hypothetical willingness to pay estimates (question format, choice based conjoint) shows an upward bias compared to willingness to pay derived with Becker, DeGroot and Marschak model (BDM) (Wertenbroch & Skiera, 2002). In addition, several studies confirm significant differences between direct and indirect methods. Differences are found between hypothetical direct (question format) and hypothetical indirect methods (choice based conjoint), as well as among the incentive-aligned direct approach (BDM) and the incentive-aligned indirect approach (incentive aligned CBC) (Miller et al., 2011).

Some studies have attempted to compare these methods to actual data. Ding et al. (2005) compared open-ended questions, choice based conjoint, the Becker, DeGroot and Marschak model and the incentive aligned CBC with regard to out-of-sample choice predictions. They found that incentive aligned CBC yielded the best results in terms of out-of sample predictions of purchase decision, followed by traditional choice based conjoint, BDM and open questioning. Miller et al. (2011) compared the same methods but in the context of measuring consumers' willingness to pay on the basis of mean willingness to pay, the resulting demand curves, and the method's ability to perform certain pricing decision tasks.

These authors also found that incentive-aligned methods yield steeper demand curves than hypothetical methods and real data. However, they also highlight that even though hypothetical methods show an upward bias, they may still lead to the right demand curves and right pricing decisions. For this reason, these methods have value in guiding pricing decisions.

#### 4.4.3 Key terms studied

The top key terms in willingness to pay research are shown in Figure 5. The number of articles that study willingness-to-pay is surprisingly low. Therefore, the cluster map offers limited information. Two methods that are found on the top key term list are auction and scanner data. The figure shows that scanner data are often used to measure price elasticity and sensitivity, while auctions are used for willingness-to-pay measures.

The correct estimation of customers' willingness to pay can improve the companies to set their prices at a correct level. However, the knowledge of, e.g., price-quality, reference price, and price endings research should be taken better into account in willingness to pay estimates.

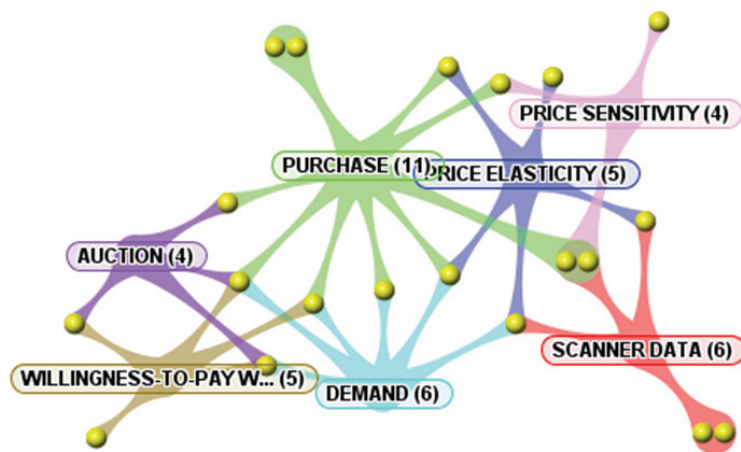


Figure 5. Cluster map of key terms used in willingness-to-pay (WTP) research.

## 4.5 The Influence of Heuristics and Biases, and Context

People use heuristics, such as rule of thumb or common sense to simplify the information processing. Such heuristics or some other shortcuts may result in ignoring evidence and result in bias. The common heuristics and biases of decision-making discussed in pricing are mental accounting, framing, and anchoring. Thaler (1980) introduced the concept of mental accounting and defined it as the set of cognitive operations used by individuals and households to organize, evaluate, and keep track of financial activities. Mental accounting refers to the tendency of people to separate their money into different accounts based on a variety of subjective criteria. Homburg, Koschate and Totzek (2010) found that mental budgeting partially mediates the negative effect of price increases on future purchases. Mental budgeting strengthens the negative effect of a price increase in the same category of expenses, whereas it does not alter the purchases in another category.

The framing effect means that presenting the same option in a different format can alter individual's decisions. In the pricing context, for example, framing a discount in absolute savings rather than in percentage can be significantly more effective for relatively high-priced products (Gendall, Hoek, Pope & Yong, 2006). In addition, the method of framing an expense into a series of small daily on-going expenses (even temporally) may decrease the perceived monetary magnitude of a consumer transaction relative to aggregate framing (Gourville, 1998).

Anchoring is a term used in psychology to describe the common human tendency to rely too heavily, or "anchor," on one trait or piece of information when making decisions. During normal decision-making, individuals anchor, or overly rely, on specific information or a specific value and then adjust to that value in their decision or response to a problem. In pricing context, the anchor may be the reference price. Usually, once the anchor is set, there is a bias toward that value. The anchoring effect may influence, for example, purchase decisions. Wansink, Kent and Hoch (1998) found that multiple-unit prices, quantity limits and suggestive selling can increase purchase quantities.

The research on context effects includes several types of topics and many of these co-occur with other behavioral pricing themes. Typical topics are, for example, choice set, reference points, price image, and background information (Liu & Soman, 2008). The purchase context has been found to influence consumers' information processing and their decision making

process (Monroe, DellaBitta, & Downey, 1977). For example, price-sensitive people perceive the price to be different compared to persons who are not price-sensitive (Willenborg & Pitts, 1977). In addition, time pressure and motivation influence the carefulness of processing the price information (Suri & Monroe, 2003).

The key terms discussed in heuristics and biases research are presented in Figure 6. The key terms on the list are similar to those in reference price research with the exception that key terms directly related to the heuristics and bias discussion are included in this list; for instance framing and anchoring.

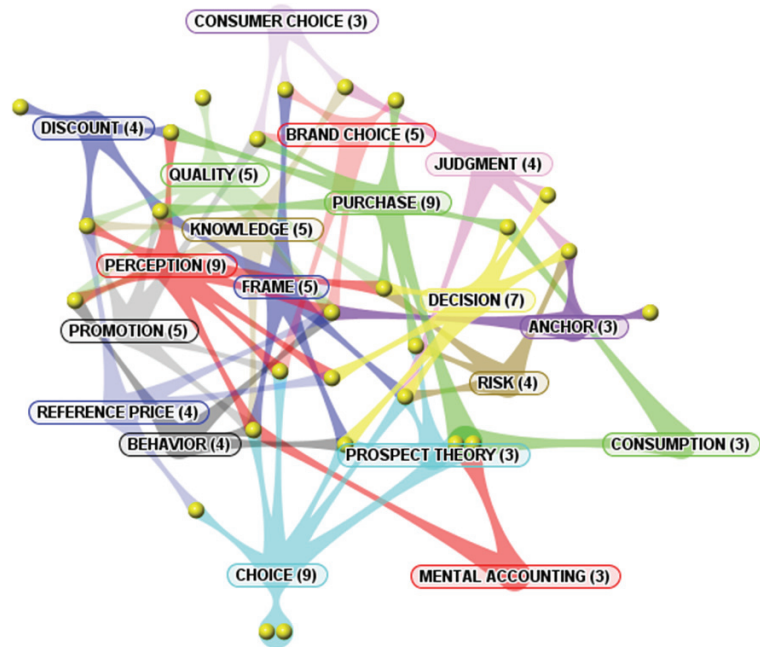


Figure 6. Cluster map of key terms used in heuristics and biases in pricing research.

## 4.6 Price Fairness

Xia, Monroe & Cox, (2004) defined price fairness as consumer's assessment and associated emotions of whether the difference (or lack of difference) between a seller's price and the price of a comparative other party is reasonable, acceptable, or justifiable.

A conceptual framework to study price fairness Maxwell (2008b) suggests the use of Rutte and Messick (1995) model of perceived unfairness in

organizations. The modification of the model to the pricing context is presented in figure 7.

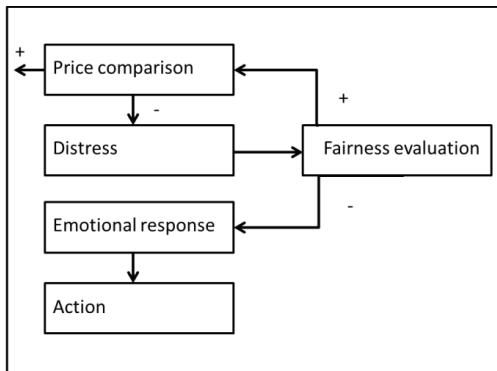


Figure 7. A conceptual model of price fairness (Rutte & Messick, 1995; Maxwell, 2008b).

People are not always concerned with fairness. The model suggests that the fairness judgment is triggered by a negatively evaluated outcome. Also Xia et al. (2004) suggest that fairness and unfairness may be conceptually different constructs. Therefore, the first phase of the model is the outcome evaluation – whether the outcome is neutral, positive or negative. In the pricing context it means that the suggested price is compared to a reference price. The reference price literature discussed earlier provides a framework for price comparison. The price fairness model proposes that when the outcome of price comparison is viewed negatively, people feel distressed and invoke thought of fairness, specifically, unfairness. When the outcome is neutral or positive, people usually don't invoke thought of fairness.

The amount of distress depends on the magnitude of discrepancy between the price being judged and the reference price (Rutte & Messick, 1995), and the context (Maxwell & Comer, 2010; Xia et al., 2004). For example, the difference between personal and social fairness has been found to influence the amount of distress. It is the difference between a price that is fair by your own standards or by society's standards. A personally fair price is low enough to meet your own expectations. A socially fair price is one that is e.g. the same for everyone, does not give seller unreasonable profits, and does not take advantage of consumer's needs. The amount of distress caused by personal unfairness has been found to be relatively mild compared to reaction to social unfairness (Maxwell & Comer, 2010).

The fairness evaluation phase identifies the rule or norm being violated and the part responsible for the outcome (Rutte & Messick, 1995). Bechwati, Sisodia and Sheth (2009) identified three situations when consumers' perceive price unfairness: 1. consumers feel that the firm is

making excessive profits; 2. consumers do not understand the pricing structure; and 3. consumers sense the firm is acting in an immoral or unethical manner. The price unfairness perceptions are more likely to occur in comparisons to other perceived similar buyers who pay a different price (Xia et al., 2004). The price unfairness perception is lower among loyal customers when the price increase is low compared to when the price increase is high (Martin, Ponder & Lueg, 2009). Furthermore, the price differences are perceived fairest when attributed to quality differences (Bolton, Warlop & Alba, 2003). The evaluation is subjective and normally done from the buyer's point of view. Therefore in price unfairness, the party that is usually perceived as causing the unfair situation is the seller (Xia et al., 2004).

According to the model the fairness judgment process may lead to the conclusion that the outcome was fair, which influences outcome evaluation in a positive manner. People may perceive that the price being judged is higher than the reference price but not unjust. For example, an unavoidable cost increase, e.g., tax increase may make the high price acceptable (Kahneman, Knetsch & Thaler, 1986). However, not all cost increases are perceived acceptable. Increased costs from managerial decisions are perceived less fair than are externally caused cost increases (Vaidyanathan & Aggarwal, 2003).

The fairness process may also lead to a conclusion that the price is unfair which will result in a negative emotional response. Maxwell (2008) argued that research in neuroeconomics suggests the response to perceived unfair prices is emotional and varies across people. The negatively valenced emotions that may result are disappointment, anger, hate etc.

These emotions may lead to no-action, self-protection or revenge (Xia et al. 2004). In no-action, the perceived price unfairness has no significant influence on people's intentions. When people are disappointed or angry, they may want to complain, ask for a refund, or spread negative word of mouth to protect themselves. A strong negative emotion leads to a tendency of aggressive behavior. Thus, additional actions such as contacting media or bringing a suit against the seller may result.

The top key terms used in price fairness research are presented in Figure 8. The top three key terms are fairness, perception, and purchase. Fairness/unfairness is considered a consumer's perception and often measured in the pricing context in the purchase situation. As the discussed price fairness model suggests, price fairness appears to be more concerned with price increases than decreases. This seems natural since price unfairness created by a price increase may be more crucial to companies than price fairness created by a price decrease. The key term "cost" is also included in the list

of top key terms. This indicates the importance of consumers' consideration of company's profits when assessing price fairness/ unfairness.

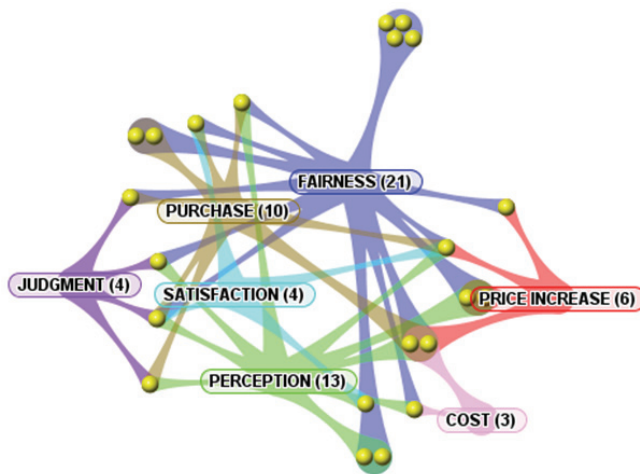


Figure 8. Cluster map of key terms used in price fairness research.

The research on the reference price concept provides a framework for understanding the first phase of the conceptual model of price fairness. In addition, a substantial amount of price fairness literature has concentrated on identifying the causes for fairness evaluations, and the influence that different variables have on fairness evaluations. However, less research has studied the emotional response and behavioral reactions to perceived unfairness in price, as can be seen by the lack of terms related to them in the top key terms used. Price fairness has been mainly studied with experimental methods and questionnaire techniques.

#### 4.7 Price-Endings

The previous literature has shown that “0”, “5” and “9” appear in the rightmost digit of a price far more commonly than chance would predict (e.g., Folkertsma, 2002; Schindler & Kirby, 1997). Folkertsma (2002) calls these attractive price points – prices that sellers believe to be appealing to consumers and divides them into three categories: 9-ending prices (if last significant digit of a price is a 9), fractional prices (amounts that are convenient to pay, such as EUR 0,20 or EUR 2, e.g. requires only few coins and only one coin or none in change) and round prices (prices are whole number amounts, often used for larger amounts). He studied 72 000 prices for 1 516 articles in the Netherlands and found out that 31% of them had 9-



ending, 12% of the prices were fractional, 24% round prices . Aalto-Setälä and Halonen (2004) looked at the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> rightmost digits and concluded that attractive prices play a very important role more generally. Many of the identified prices in grocery stores and car industry in Finland used a combination of 9-pricing and round pricing. The prices typically ended in “0” but “9” occurred at some digit of the price. Typically, the higher the price, the further from the rightmost digit they found 9-pricing. A smaller share of the prices was 5-prices with round endings. These two types of prices represented the majority of all the prices used. The introduction of euro in 2002 in 12 EU countries provided a natural market experiment of the adjustment to price endings. The national currencies were replaced by euro using a fixed exchange rate and no price adjustments were allowed during the transition. The research shows that the euro changeover resulted in a distortion of existing price patterns. However, in the long run the national currencies were changed too prices (Aalto-Setälä, 2005; Folkertsma, 2002; Sehity, Hoelzl & Kirchler, 2005). The adjustment process was very slow, though (Aalto-Setälä, 2005).

The research has found evidence that 9-digit price ending can have a positive effect on sales (e.g. Schindler & Kibarian, 1996) and recommends companies to use 9-ending prices, unless they suspect strong quality-image effects associated with price endings (Gedenk & Sattler, 1999).

It has been suggested that nine-ending prices may sometimes be perceived to be lower than a price one unit higher; 0.99 vs. 1 (Thomas & Morwitz, 2005). A number of psychological mechanisms have been proposed to account for the effects of 9 pricing. One mechanism is called drop-off mechanism. This mechanism suggests that people have a tendency to minimize the information processing effort and as numbers are processed from left to right they easily ignore or pay less attention to a price's right most digits (Bizer & Schindler, 2005). Another effect discussed is called association mechanism. That suggests that 99-ending communicates an image that the item is low-priced or on sale (Schindler, 1991).

The key terms found in price-ending research are presented in Figure 9. Typical price-ending studies discuss the effect of 9-ending or other odd-endings. The top key terms describe the typical application area; a purchase situation in the retail market, and advertised price. The research methods that have been typically used are statistical analyses of real market data and experiments. The real market data has been used to identify the existing price patterns, while experiments are used to study the underlying reasons for identified price patterns used.

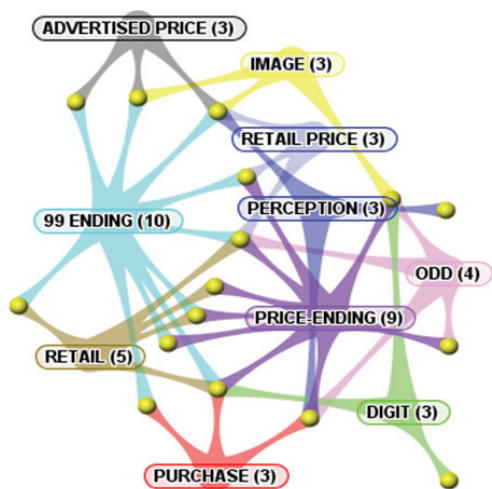


Figure 9. Cluster map of key terms used in price-ending research.

## 5. FURTHER RESEARCH PROFILING ANALYSES

The most studied areas in behavioral pricing are the price-quality relationship and the reference price. The number of studies in other areas is smaller as can be seen in Table 4.

Topic	Number of articles
Price-quality relationship	62
Reference price	60
Price information processing	36
Willingness to pay WTP	30
Heuristics and biases, and context	30
Price fairness	24
Price-endings	18
Other	40
Total number of articles	290*

Table 4. The number of publications with respect to each topic.

\*Note. Some articles may be assigned to many subcategories. Therefore the total number of articles is less than the sum presented in the subcategories.

One reason for the small number of studies is that the field is fairly new, and some topics in behavioral pricing have evolved only recently (see Figure 10). The price-quality relationship interested early researchers and the topic was the most studied before 1980. The topic continues to be a popular research topic. The second theme that attracted more attention was research on reference price. After 1985, the number of studies on reference price has grown steadily. The topics price fairness, heuristics and biases, and price-endings have all evolved fairly recently and have flourished more since the turn of the millennium. Willingness-to-pay has attracted relatively little attention in marketing; however, it has received some attention throughout the period.

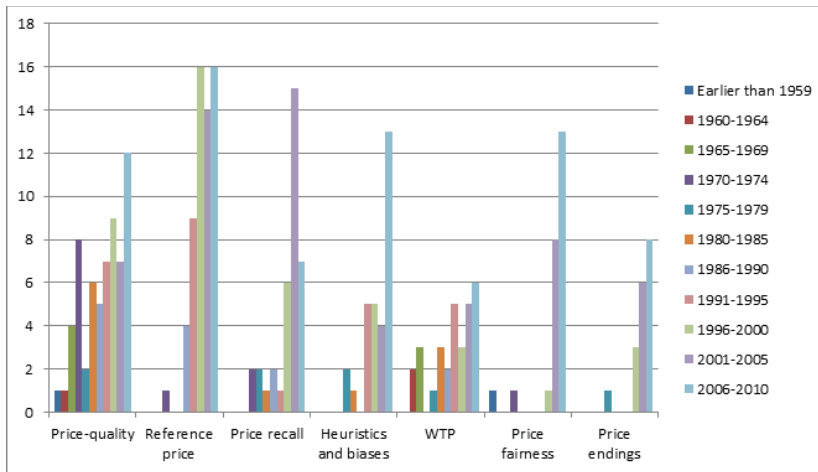


Figure 10. The number of publications in each topic every five years.

The most prolific authors, affiliations, and journals relating to publications on behavioral pricing are presented in Table 4. Kent Monroe is the most productive author in the field, followed by Abhijit Biswas, and Dhruv Grewal. All affiliations in the top 10 list are universities from the US.

Typical journals for behavioral pricing research publications are journals that study consumer behavior (Journal of Consumer Research being first ranked overall – i.e. most articles) and general marketing (Journal of Marketing Research being second ranked overall). The field of retailing has also attracted behavioral pricing research, because many of the articles study grocery products in the retail environment. The Journal of Product & Brand Management has been especially active. This review included JPBM articles only after 2000, and despite the short time span, in the review the journal is placed in the 4<sup>th</sup> position on the top 10 journal list. However, this journal is the only journal that is specifically concerned with pricing. Initially the section on pricing in JPBM began a separate journal and it was later merged into JPBM.

Top 10 Authors	Top 10 Affiliations	Top 10 Journals
Monroe, K B	Univ Penn	Journal of Consumer Research
Biswas, A	Univ Florida	Journal of Retailing
Grewal, D	Univ Illinois	Journal of Marketing Research
Lichtenstein, D R	Carnegie Mellon Univ	Journal of Product & Brand M.
Schindler, R M	Louisiana State Univ	Journal of Business Research
Raj, S P	Syracuse Univ	Journal of Marketing
Tellis, G J	Miami Univ	Marketing Science
Bearden, W O	Univ So Calif	Psychology & Marketing
Burton, S	Babson Coll	Journal of The Academy of Marketing Science
Hardesty, D M	NYU	Journal of Business

Table 5. The top 10 authors, affiliations and journals in behavioral pricing.

The most common key terms studied in behavioral pricing were identified from words on titles, key words and abstracts. The top 43 key terms, each appearing at least 9 times, are presented in Figure 11. In the auto-correlation map, each node represents a key term and the size of the node reflects the number of articles addressing the key term. The lines between the nodes show the correlation (Pearson's  $r$ ) between the key terms as described in the legend. The figure presents all correlations between the key terms for which  $r > 0.20$ .

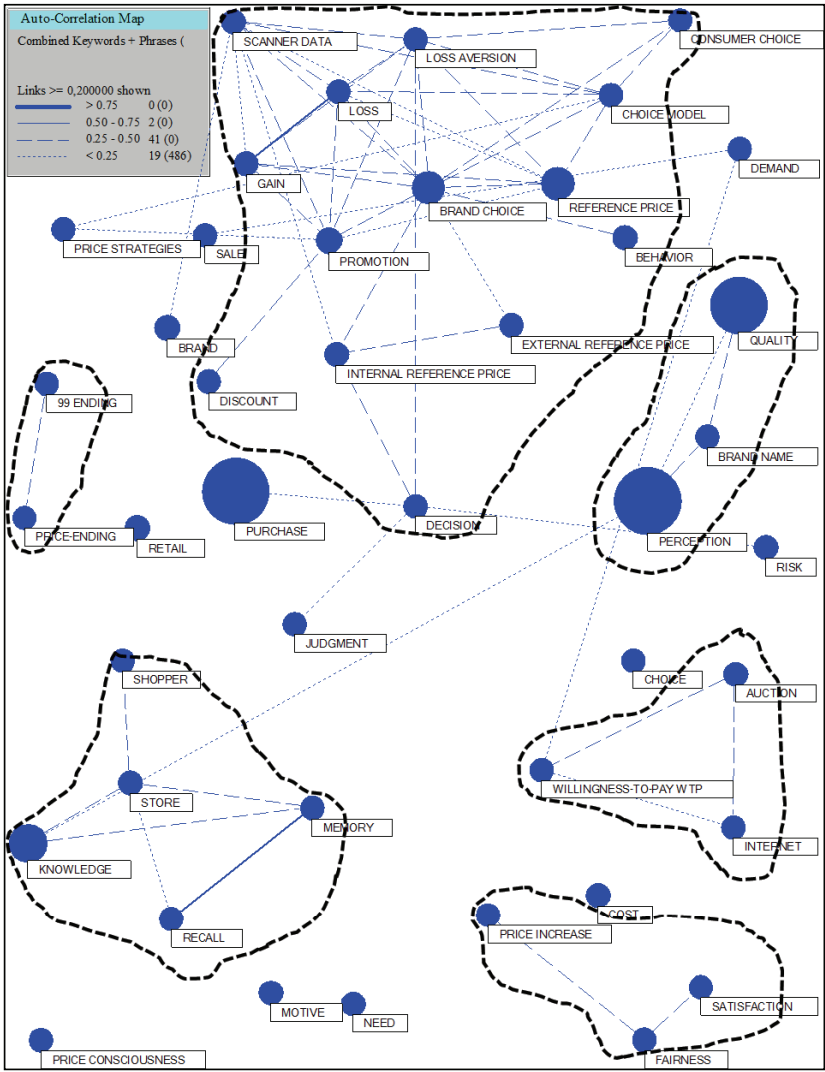


Figure 11. Auto-correlation map of top 43 key terms.

From the auto-correlation analysis six subfields of behavioral pricing emerge that are circled in the map. The largest network includes topics studied in reference price research. At the core of the network are key terms such as brand choice, reference price, promotion, discount, loss aversion, loss, gain, scanner data, consumer choice, choice model, external reference price, and internal reference price. All these key terms are central research topics in the reference price literature. The auto-correlation map shows how these themes link to other subfields.

The second network includes price-quality relationship research, including the key terms quality, brand name, and perception. The third network includes the key terms willingness-to-pay, auction, and internet. The fourth network is price fairness. The key terms here include fairness, price increase, and satisfaction. The final network includes the key terms 99-ending and price-ending. The subfields that emerged from the auto-correlation analysis are almost the same as those discussed in the previous section. Only the category heuristics and biases in pricing is now absent; most likely this is included in the network of reference price research. The auto-correlation map thus appears to confirm the existence of the identified main subfields in behavioral pricing.

The size of a node represents the number of articles including the term. The biggest nodes presented on the map are quality, perception, and purchase. The research on price-quality is one of the first behavioral pricing subfields that attracted larger attention and over the years it has retained its popularity. Perception and purchase are, by nature, fairly general terms in behavioral pricing research because such research is specifically interested in price perception and prices' influence on the purchase decision. Therefore, it is natural that the terms are largely used; however, they are not used in all articles.

On the map, the key terms that are close to each other are more similar than those that are more distant. However, the presence or absence of a line between any two key terms is a more appropriate measure of proximity, because it implies a relatively high correlation between them. At the center of the map are located terms such as decision, judgment, purchase, perception, and retail. Behavioral pricing research uses theories from behavioral decision making research, and centrality of the terms of decision and judgment depict that well. In addition, the research is often conducted in a retail context.

The terms that are the most distant from each other are at one end scanner data, consumer choice, and loss aversion, and at the other end fairness and satisfaction. One reason for distant locations may be the difference in research methods used. Whereas with regard to scanner data,

consumer choice, and loss aversion refers to statistical modeling, topics such as fairness and satisfaction are typically studied experimentally.

Figures 12 and 13 present the same auto-correlation map with additional information: Figure 12 with author information, and Figure 13 with journal information. The auto-correlation map of key terms including author information shows the active authors in each key term. Since the review area is relatively small, some of the top authors are active in all key terms, e.g. Monroe. Similarly, the auto-correlation map of key terms that includes journal information shows the journals that have published the most articles discussing the key term. All the top 3 journals (Journal of Consumer Research, Journal of Retailing, and Journal of Marketing Research) appear to have been active with regard to all key terms.

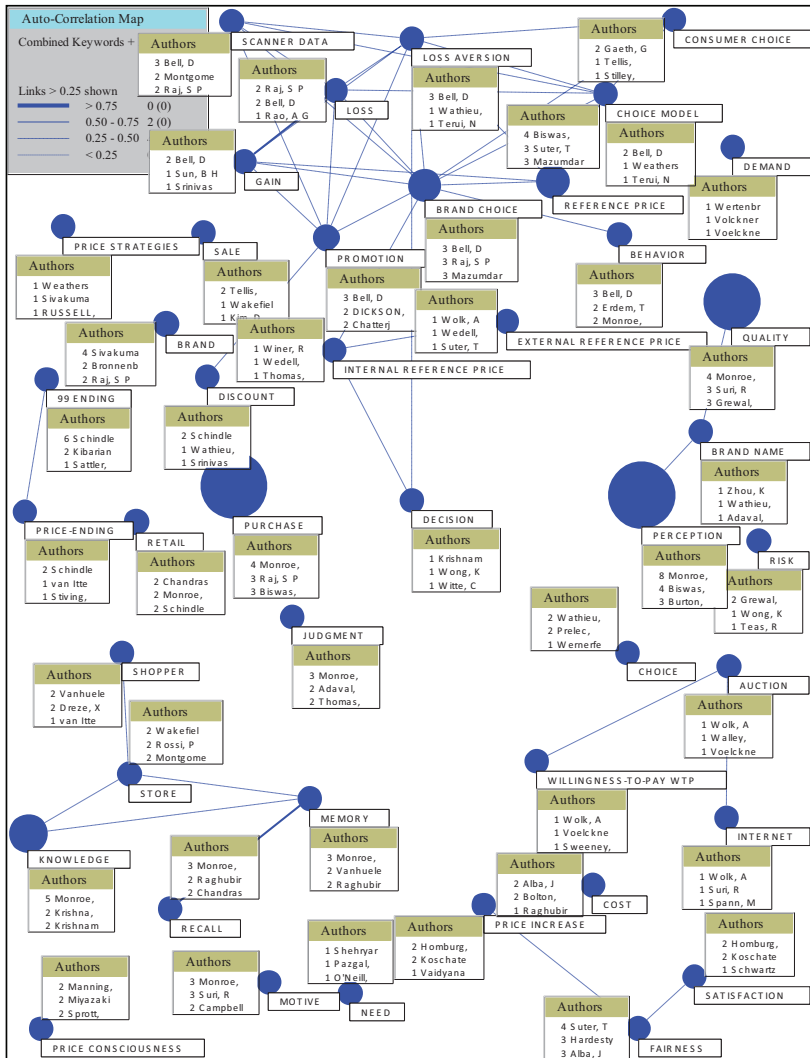


Figure 12. Auto-correlation map of top 43 key terms including author information.



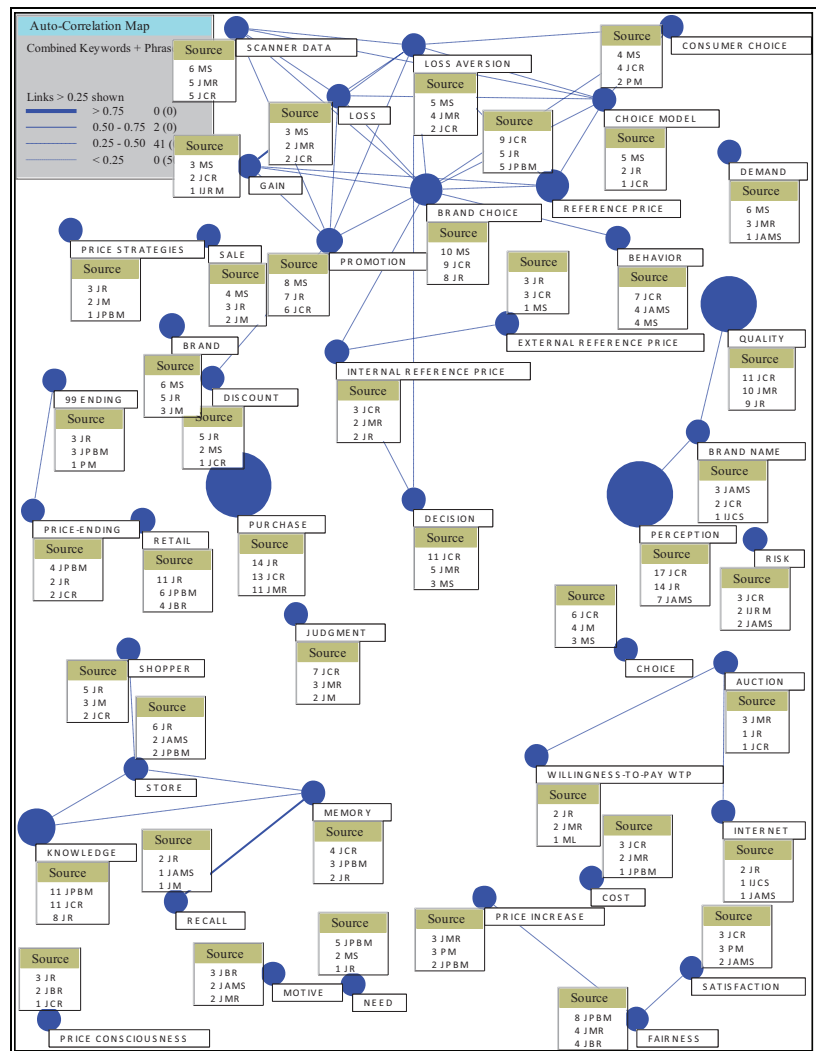


Figure 13. Auto-correlation map of top 43 key terms including journal information.

## 6. DISCUSSION AND CONCLUSIONS

Mizayaki (2003) has defined the psychology of pricing in terms of the way it looks at how humans attend to, perceive, process, and evaluate price information. Following this tradition, the main objective of the research presented in this paper was to identify the core of behavioral pricing research. Based on previous research (Gijsbrechts, 1993; Gourville, 1999; Liu & Soman, 2008; Monroe, 1973; Parsa & Njite, 2008; Winer, 1988) the identified subfields of behavioral pricing are 1) price/ perceived quality relationship, 2) reference price, 3) price awareness, 4) measurement of willingness-to-pay WTP, 5) heuristics, biases and context in pricing, 6) price fairness, and 7) price-endings. This study discussed the key topics in each identified subfield, and showed how and by whom the research evolved.

The most researched areas in behavioral pricing are price-quality relationship and reference price. The most researched areas during last five years have been reference price (16 published articles in marketing journals during last five years), heuristics and biases in pricing (13 published articles) and price fairness (13 published articles). Considering the importance of pricing decisions to companies, the quantity of research in this area is small. Our understanding on how humans attend to, perceive, process, and evaluate prices is still very limited. All subareas would benefit from additional research with a richer variety of contexts, products, industries, and individual characteristics. On the other hand, behavioral pricing research is full of good research opportunities. Some research opportunities are discussed below.

Research in behavioral pricing has produced much important information. For example, contemporary research recognizes that a price may have a role as a cost (or sacrifice) and as an indicator of perceived quality. Together these constructs form the perception of value (Monroe, 2003; Zeithaml, 1988). In addition, marketing literature generally agrees that consumers use a reference price to compare a product's price rather than consider only the perceived value or utility of that product (Kalyanaram & Winer, 1995). The pricing researchers have studied widely the cognitive aspects of the formation of reference prices and reference

price effects on the purchase decision and product evaluation. We have learned that context, e.g. last price paid, competitors' product prices, and advertised prices are important cues in reference price formation. However, even though the adaptation level theory suggests that organic (human processes) cues are also important in reference price formation, nearly no studies discuss them. A possible future research idea is to study, for example, the role of emotions and motivation in formation of reference price. In addition, emotion and motivation may have a role in reference price effects on the purchase decision and product evaluation. Current research in decision-making suggests that emotional processes are involved in every decision (e.g. Griskevicius, Shiota & Nowlis, 2010). Their role in pricing context is unknown.

Reference price research has also identified that there is an acceptable price range around the reference price, where prices may not affect choice if the change is sufficiently small (Terui & Dahana, 2006). In addition, several studies have discussed how people respond to positive and negative differences between the reference price and the price they are judging, and loss aversion. However, the reference price effects on demand have been far less studied, even though, demand is from practical point of view a more interesting parameter.

The behavioral pricing research has been especially strong in identifying anomalies that challenge the traditional economics assumptions of how people respond to price information. For example, the research has found that consumers typically have poor price recall of exact prices of a product they just purchased (Estelami & Lehmann, 2001). A few studies have tried to understand the reasons for poor price awareness and they found that conscious/ unconscious information processing, memory and number processing difficulty may explain why the price recall is poor even though people may actually have a good understanding of the "deal goodness" of the product they just purchased (Luna & Kim, 2009; Monroe, 2003; Monroe & Lee, 1999; Vanhuele, Laurent, & Dreze, 2006). However, more empirical evidence is needed to draw further conclusions of the work. Enhanced empirical work on price information processing should lead to improved theoretical work. One reason for the lack of empirical research is that human processes are difficult to study. However, the advent of psychophysiological methods in psychology has made it possible to include reliable measures of emotional, motivational and memory processes also into pricing research.

The internet and mobile devices have changed the way consumers can search for price information and evaluate product or service quality, e.g. web sites or phone applications that list best prices, or travel sites where

customers can rate their hotel/ travel experience. In addition, the outlook of future mobile phones that may be used, for example, as means of payment, may potentially change the entire purchasing arrangement. This technology applies especially to consumer durable and services markets. This has created a need to study the old topics with new lenses. Some research has studied the psychology of internet and e-commerce pricing (e.g. Miyazaki, 2003), but less can be found that would include the internet or mobile devices in price processing in general business. The changed world may have implications for all behavioral pricing research areas; for example, for price-quality knowledge, or for formation of internal reference price.

Furthermore, Nowlis and Simonson (1997) claim that product attributes differ in the degree to which they may be meaningfully evaluated in the absence of a context. They argue that some attributes, for example, brand quality are context independent, but others, such as price, are extremely context dependent. Evaluation of the price attribute is difficult and unreliable in the absence of context. For this reason, greater diversity in context, background information, choice set etc. should provide a better understanding, especially of how people attend to and process price information.

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Journal name	Journal abbreviation	First year of review*
Journal of Consumer Research	JCR	1974
Journal of Retailing	JR	1956
Journal of Marketing Research	JMR	1964
Journal of Product & Brand Management	JPBM	2003
Journal of Business Research	JBR	1973
Journal of Marketing	JM	1936
Marketing Science	MS	1987
Psychology & Marketing	PM	1994
Journal of The Academy of Marketing Science	JAMS	1997
Journal of Business	JB	1954**
International Journal of Research in Marketing	IJRM	1997
Harvard Business Review	HBR	1922
Marketing Letters	ML	2001
European Journal of Marketing	EJM	1971
Journal of Advertising Research	JAR	1960
Journal of Public Policy & Marketing	JPPM	1984
International Journal of Consumer Studies	IJCS	1995
Journal of Advertising	JA	1984
Journal of Interactive Marketing	JIM	1995
MIT Sloan Management Review	MIT	1970

Appendix 1. List of marketing journals included in the review.

\*Review conducted of articles from first year of review until end of 2010.

\*\*The journal ceased publication in 2006.





## Essay II

Halme Merja and Somervuori Outi: How do prices above and below the reference price affect the demand for a service? A conjoint analysis approach.



# **How do prices above and below the reference price affect the demand for a service? A conjoint analysis approach.**

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## **Abstract**

The purpose of this study is to estimate how a price that is higher than the reference price and a price that is lower than the reference price, similar in size, affect the purchase probability for three, at least partly, compensatory services. The existence of a reference effect in pricing has been commonly accepted. However, the observations of consumer choices with prices below and above the reference price have produced mixed results. Both symmetric and asymmetric behavior has been observed. The current study differs from the mainstream in that the object is a service and instead of scanner panel data, stated preferences measured by choice based conjoint analysis are used. Moreover, instead of dealing with changes in value caused by price changes, we consider changes in demand on the respondent level. The respondents showed different behavior towards different services. The demand for the 'traditional' service reacted asymmetrically to changes in prices, while the reactions to the two 'modern' services were mixed: both symmetric and asymmetric.

Key words: pricing, reference price, asymmetric price behavior, prospect theory, services

# 1. Introduction

In marketing theory, the reference price concept is well accepted; consumers evaluate their choice alternatives' prices not only in absolute terms but against a reference price. This information is important especially for developing pricing strategies. With reference prices the presence of loss aversion is often observed. Loss aversion means that a consumer observing a price above his/ her reference point (a loss) reacts more strongly to that than a price below the reference point (a gain). The opposite behavior is called gain seeking. Kahneman and Tversky's (1979) prospect theory included both reference effects and loss aversion as its key constructs and its deterministic analogy has been used in pricing.

Reactions to changes in prices have been extensively studied during the last decade using scanner panel data of frequently purchased grocery products. Numerous studies support loss aversion (e.g., Kalwani et al., 1990; Putler, 1992) though contradictory evidence has also been found (Bell and Lattin, 2000). For example, Mazumdar and Papatla (1995), found some product categories where consumers were more responsive to gains than to losses. Klapper et al. (2005) proposed that consumer characteristics may be used to analyze the extent of loss aversion. Overall, only a limited understanding has been achieved with regard to reactions to prices that differ from a person's reference price.

Our main focus is to consider how a price that is higher than the reference price and a price that is lower than the reference price, similar in size, affect the purchase probability of a service or, on the aggregate level, the relative demand. Are the effects symmetric or not? It is also of interest if these effects are different in the three compensatory services considered, of which one is traditional, familiar to all, and the other two more modern.

Our study differs from the mainstream of earlier work in a number of aspects. The object is a service, not a commonly used everyday low-involvement product as is the case when scanner panel data is used. Prospect theory in services has been studied to some extent - however, not when the pricing is at the core of the interest. Thus all our benchmark studies are on the field of products. However, service pricing has been studied but not from the observed gains and losses and the reference price

point of view. We study three different, at least partly, compensatory services at the same time. Two of the three services are new and do not have a market price. The situation is exceptional also in the way that we are using an external fixed reference price, the price of the single existing service. In addition, instead of scanner panel data we use stated preferences to study the effects of price changes (also e.g. Agarwal, 2002). This allows us to measure the preferences of the same individuals for both gains and losses. To elicit preferences we use Choice-Based Conjoint Analysis (CBC), which allows us to estimate utility functions on the respondent level and consider the behavior of individuals around the reference price. So far we have not found very many studies on price gains/losses with individual choice models and we are not aware of any other research studying specifically loss aversion and prices with individual models estimated by conjoint analysis though the method is frequently used to study pricing effects. Finally, unlike previous research with multinomial logit as the choice model we consider loss averse and gain seeking behavior based on response in demand rather than in value. As choice behavior is explicitly included in the estimation it seems to be a natural alternative. Also it is much more intuitive to study relative demand changes with percentage units than interval scaled utility increments with no natural unit. Loss aversion in demand takes place if the expected decrease in demand resulting from a price increase from the reference level is greater than the increase in demand due to an equal price decrease. We will also point out that owing to the characteristics of the multinomial logit choice model loss aversion (or gain seeking behavior) in utility does not necessarily imply loss aversion (or gain seeking behavior) in demand. For example, Fibich et al. (2005) also studied the impact of price changes from the reference level on demand but in a dynamic setting.

The use of scanner panel data for individual level gain/ loss evaluation requires a number of purchases from the same category. That imposes a severe restriction on the product categories for which such analysis can be carried out, i.e. products with repeated purchases. In the case of services that kind of data is usually unavailable as the purchase occasions are normally not frequent. If conjoint analysis or some other preference measurement method is used for price evaluations, such limitations do not exist. In this case, we may evaluate the prices of products/ services not in the market with no historical data. Choice-based type of conjoint analysis data is a natural alternative to replace scanner panel data, as it makes the respondent choose among alternative product profiles instead of rating or ranking alternatives (as done in metric conjoint analysis). Scanner panel data reports real choices made while in choice-based conjoint analysis

choices are simulated, no monetary consequences appear and no external factors are taken into account. Even with its limitations, market shares produced by conjoint analysis are quite commonly used as data when predicting real market shares. We point out that in our study we

concentrate on - not the market share levels but changes in market share (or, in individual choice probability). Some recent papers have put forward procedures to improve the market share predictions produced by conjoint analysis (Gilbride et al., 2008; Bowditch et al., 2003).

The representative sample used in our study is relatively large. We surveyed 1141 teachers to whom the services studied are relevant in everyday work, and/or were becoming increasingly relevant at the time of study. The service in the focus of this study is a license permitting to reproduce and deliver copyrighted material from Internet by teachers on all educational levels from primary schools to universities. A representative quota sample of Finnish teachers responded to a choice-based conjoint questionnaire, where price was one attribute. The study was carried out in 2005.

The rest of this paper is organized as follows. In section two, the previous literature is discussed. In section three, the methodology, the empirical study and the data are explained. The results are described in section four and section five consists of discussion and conclusions.

## 2. Reference prices and loss aversion in consumer choice

Prospect theory (Kahneman and Tversky, 1979) considers a value function over gains and losses from a reference point (see also Korhonen et al., 1990). According to this theory there is a kink at a reference point in the individual utility functions which is at that point asymmetric, steeper for losses than for gains. The study of loss aversion in the pricing context was first suggested by Thaler (1985). Several studies have examined issues related to reference prices. Some studies focus on reference price formation (e.g. Biswas, Wilson and Licata, 1993; Moon and Voss, 2008). Another stream concentrates on the behavior around reference price. Most of the research in this area models alternative reference price formulations and tests different effects with calibrated consumer panel data (e.g. Putler, 1992; Hardie et al., 1993; Bell and Lattin, 2000; Krishnamurthi et al., 1992; Mazumdar and Papatla, 1995). All the studies used frequently purchased grocery products.

In general, several models have been used to study the effect of reference prices. The first stream of models aggregating homogeneous data has discovered the effects of loss aversion (Kalyanaram and Winer, 1995; Kalwani et al., 1990; Mayhew and Winer, 1992; Putler, 1992; Hardie et al., 1993). The second stream included price response heterogeneity in the model (Bell and Lattin 1993). Bell and Lattin claimed that “loss aversion may not in fact be a universal phenomenon...”. Other studies that also found heterogeneous price responses include (Krishnamurthi et al., 1992; Mazumdar and Papatla, 1995; Erdem et al., 2001; Klapper et al., 2005). Another modeling stream incorporates price thresholds, i.e. models that recognize that individuals have a range of prices around the reference price within which individuals demonstrate no observable changes in demand (Han et al., 2001; Terui and Dahana, 2006). Terui and Dahana (2006) introduced a model with heterogeneous price thresholds. They also applied the homogeneous and heterogeneous models without price thresholds as well as heterogeneous models with thresholds in their data. They concluded that the model that used homogeneous data showed loss aversion most clearly, the model that incorporated heterogeneity without price thresholds

may make the reference price effects disappear. The third model yielded results between the first and second model. Thus, the varying model specifications have been claimed to be one reason for inconsistent research results (Rajendran & Tellis, 1994; Terui & Dahana, 2006). In addition, as the previous studies measure asymmetric price response effect on value, no exact conclusions may be drawn on consumer response to demand (Kallio & Halme, 2009). Few studies have used other approaches than modeling of scanner panel data to study consumer choice around reference prices. Hankuk and Aggarwal (2003) measured directly the “perceptions of gains and losses”.

The previous studies suggest that the consumer response to symmetric price changes may be symmetric, loss averse and gain seeking. However, the conclusions are somewhat contingent due to criticisms concerning the models used and narrow research approaches used. Therefore, we find a need to revisit the problem using a method that measures individuals’ responses on demand rather than value and allows analysis in a product or service category other than low-involvement grocery products. This leads to our first research question:

Q1: How do a price that is higher than the reference price and a price that is lower than the reference price (the price difference from the reference price being equal in magnitude) affect purchase probability or relative demand of a service?

Some studies have attempted to identify characteristics of consumers or products that could be linked with loss averse or gain seeking behavior (e.g., Mazumdar and Papatla, 1995; Erdem et al., 2001; Klapper et al., 2005). We briefly discuss some observations.

### **2.1.1 Consumer loyalty and price sensitivity**

Krishnamurthi et al. (1992) concluded that loyal customers exhibit symmetric behavior towards losses and gains, whereas non-loyal customers show strong asymmetry. Non-loyal customers are more responsive to gains than to losses. A possible explanation is that the non-loyal customers may be more price sensitive to price decreases. That is, they are more likely to purchase when the price is reduced, but since they are not loyal are less likely to buy when the price is increased.



### **2.1.2 Product quality and quality consciousness**

Klapper et al. (2005) found that non-quality conscious consumers exhibit loss aversion and quality conscious exhibit less loss aversion. Hankuk and Aggarwal's (2003) experiment on high and low quality-tier products identified that loss aversion occurred only with low quality-tier products. Consumers showed gain seeking behavior towards products that have high quality-tiers.

### **2.1.3 Promotional level**

In the margarine and liquid detergent category, consumers behaved differently in their choices around the reference price. Margarine shoppers were more responsive to gains, whereas liquid detergent shoppers were more responsive to losses. Mazumdar and Papatla (1995) suspect that the reason lies in the differences in promotional levels - the level of promotion is much higher in liquid detergents than in margarine, and consumers may exhibit greater aversion to paying regular prices.

This leads us to expect gain seeking behavior to be strong when the customer looks for a good deal (price sensitive) and the product or service offers superior benefits in addition to lowered price (high-quality tier product). Also the literature on promotion effects almost unanimously agrees that the price decreases in higher quality brands attract more consumers than do price decreases in lower quality brands (Allenby & Rossi, 1991; Blattberg & Wisniewski, 1989; Bronnenber & Wathieu, 1996). In our study this will be tested among three different services that vary in their novelty. The second research question is:

Q2: Are the price response effects different for services that vary in their novelty?

### **3. The empirical study and the research methods**

#### **3.1 The study and the sample**

The service under study is a license to reproduce and deliver copyrighted Internet material in education. The study started with qualitative interviews to characterize the different facets of Internet use in classrooms. At least one teacher was interviewed at each education level. Altogether a convenience sample of seven technically well-equipped schools was selected. The principals were asked to select a teacher who used Internet and digital material substantially. Each teacher then had a visit lasting 45-90 minutes from two of the research group members. The purpose of the interviews was to outline the situations in which the Internet was used, how and how much the material was reproduced, and what were the future visions for use.

Attributes of major importance to users were the website content as well as the way material is copied and distributed (later referred to as the type of reproduction). The price attribute brought realism into the study making the respondents make trade-offs.

The three alternative ways/ types of reproduction were defined as: 1. printing the material to students, 2. showing the material as part of own presentation in class or 3. loading the material to the school intranet/ sending via e-mail. In the sequel, we will call these alternative delivery types service1, service2 and service3. There has been a license available for service1 (called the traditional service) for several years, but not for the other two more modern types of delivery. Teachers are, however, familiar with the modern service types, as they may distribute e.g. their own digital material through these channels. It should be noted that intranet was relatively well developed at the time of the survey only on the highest educational levels.

For the sample, the educational sector was divided into twelve education levels and in them quota sampling was applied using a web link which contained the contact information of the majority of educational institutions. Web questionnaires were sent to teachers in the sample by e-

mail with an invitation including a link to the study. Some schools on the primary and secondary level were mailed hard copies of the questionnaire. This was because some of the schools were not on the list used as a source in sampling. The hard copies were mailed to the principals of the schools with a request to distribute them to all teachers. The schools chosen for paper questionnaires were selected by random sampling.

Altogether 1141 teachers participated in the study with the response rate being 33 percent (Appendix 1). Each teacher was presented with 15 choice tasks which included two hold-out tasks, the same for all. The design of the conjoint tasks was such that each respondent had a version of her own of the conjoint questionnaire. Each choice task included three profiles. The respondent indicated each time the most preferred one among the profiles shown (see an example of a question in Appendix 2). The profiles included three attributes (their alternative values are presented in Appendix 3). The attribute values, the preferences of which were measured in the study, were selected on the basis of teacher interviews. In the web based questionnaire it was pointed out that no attention should be paid to the fact that some of the services were not yet available.

### **3.2 The price attribute**

In 2005, the teachers' material use was covered with a collective license for photocopying and printing. The collective system, however, was expected to change with the digital copying becoming more important with more diversified copying needs. In Appendix 4, the teachers' role as more and more important decision makers is viewed. In the questionnaire, the respondents were asked to consider the prices presented from the point of view what they considered fair.

A different normal price was set to each service and for each service two alternative price levels were defined, which were 50 % above and below the reference price. The prices were set in "euro per student per year" for historical reasons. The big challenge lay in choosing the reference prices. The teachers had not been involved in the purchasing of the licenses and were not generally aware of even the price the ministry was paying for the printing and photocopying. The existing price was 4 euro per student per year and – in the absence of any other reasonable alternative - this was chosen to be the benchmark for all the remaining prices present in the study. The possible non-existing license prices for digital copying (for services 2 and 3) were expected to be remarkably higher owing to the copyright owners' concern on the copies' high quality and easy large-scale distribution. The reference price of service1 was multiplied by 1.5 and 2.5

to produce the reference prices for service2 and service3. Similar multipliers were used in pricing, e.g., in Denmark. The differences in the estimated reference prices for the three services are considerable. However, these estimates turned out to be good ones when comparing them with some existing prices four years later (see Appendix 5).

In the study, the reference price was thus given externally to the respondents. In the questionnaire the prices had three values: normal price, “normal price + 50%” and “normal price – 50 %”. Previous research suggests that the context in which a product or service is seen influences reference price formation (see Mazumdar, Raj & Sinha, 2005 for a review). Context may be, for example, the last price paid and the range of prices of similar alternatives. In our case, the teachers do not as a rule have a priori purchase experience of copyright licenses, and the existing photocopying license fee was also unfamiliar to them (Appendix 4). Therefore, the respondent could not have formed internal reference prices for the service. In addition, there had been only one service provider for copyright licenses in education. In the instructions the respondents were told the normal price levels of each service type. Further in each question, the respondents were cued whether the prices were normal, above normal, or below normal. Because the respondents did not have any other price information available, they could not use any other reference price than the one cued them in each questionnaire.

In addition to reference price, one price level above (below) reference price +50% (-50%) were chosen. An additional level for price would have made the questionnaire too exhausting. Thus we are not able to assess the diminishing sensitivity characteristic of the value function of prospect theory.

At the end of the study, the teachers were directed to a web site where comments were requested. Viewing the hundreds of comments received it could be seen that the respondents had correctly foreseen their role as more and more important decision makers and buyers of digital material in the years to come. Also our concern about the acceptance of the prices used was relieved; the “high” reference prices of services 2 and 3 or the common-for-all reference prices did not ignite any opposing comments.

### **3.3 Choice-based conjoint analysis**

Conjoint analysis (CA) techniques are often called discrete choice experiments. It typically uses stated preferences of hypothetical products or concepts. It (e.g. Green and Srinivasan, 1978) is based on multi-attribute utility theory according to which products/services are composed of

multiple attributes that contribute to consumer satisfaction. It works by breaking down a product into a number of attributes and their specified values (levels). A product is represented by a profile with defined values for the attributes. The respondent then is systematically presented with possible hypothetical products and states his/her preferences in some way. On the basis of this information he/she provides the respondent's value function is estimated. In addition to individual value functions also aggregate functions can be estimated. An appealing feature is that one attribute can be, and often is, price which enables also economic analysis. Different approaches exist as how to present the hypothetical products and especially what kind of questions are asked on the products. Also different approaches exist as how to define the design, i.e. how to specify the products offered for evaluation.

All the attributes have only a finite number of possible attribute values. Conjoint estimation produces the partial utilities as well as the importance of each attribute. In a conjoint analysis, partial or full profiles are typically used in preference elicitation tasks. Full profile is a concept where a level is specified for all the attributes and a subset of attribute levels is defined in a partial profile. The approach we employed, Choice Based Conjoint Analysis (CBC) (software : Sawtooth Software SSIweb, 5.0; Orme, 2006) offers a predefined number of profiles in each task. Of all the possible profiles offered in a task, the respondents only choose the one they prefer. Thus the preferences are given in a simple form. Our study consisted of 15 tasks, all with three profiles. In a web-based questionnaire the set of tasks for each respondent can be unique We used randomized experimental question design, where respondents are randomly selected to receive different versions of the choice sets. The choice sets were created as suggested by Chrzan and Orme (2000). We had two holdout tasks that were used to calibrate the value functions.

The total utility of a product/service profile is a function of its attribute values. Utility functions measure perceived value and consist of the deterministic part called the value function (total value  $V$ ) and the random error term  $\varepsilon$ .

$$U = V + \varepsilon \quad (1)$$

Choice-based conjoint analysis (CBC) can use the simple additive value function, which with  $P$  attributes  $a_1, a_2, \dots, a_P$  is

$$\text{total value } V = v_1(a_1) + v_2(a_2) + \dots + v_P(a_P) \quad (2)$$

where  $v_1, v_2, \dots, v_P$  are value functions for the attributes.

A more general value function takes into account attribute interactions. Assume that one 2-way interaction term of attributes  $i$  and  $j$ ,  $i \neq j$ , is included. Then the total value  $V$  becomes

$$V = v_1(a_1) + v_2(a_2) + \dots + v_P(a_P) + v_{P+1}(a_i, a_j), \quad (3)$$

where  $v_{P+1}$  is a value function of two attributes.

The choice model that CBC uses is multinomial logit. The error terms are assumed to be independent and identically Gumbel distributed (Bierlaire, 1997). When  $K$  profiles with the corresponding total values  $V^1, V^2, \dots, V^K$  are offered for evaluation the probability that the  $k$ th profile ( $k = 1, \dots, K$ ) is chosen is

$$\exp(q \cdot V^k) / [\exp(q \cdot V^1) + \exp(q \cdot V^2) + \dots + \exp(q \cdot V^K)] \quad (4)$$

where parameter  $q$  can be estimated using hold-out tasks of the conjoint questionnaire. The relative demand can be simulated using, e.g. (4) as the choice rule (Orme, 2006, p. 139).

The individual value functions were estimated using Hierarchical Bayes estimation (Lenk et al., 1996). This is a standard estimation method when individual utilities are required. Its measure of fit, root likelihood (rlh), is the geometric mean of the probabilities that the estimated utilities predict the correct concept choices. It can be compared with the uniform choice probability which is, in the case of  $K$  alternatives in each choice task,  $1/K$ .

The value of the Hierarchical Bayes model “lies in its ability to characterize heterogeneity in preferences while retaining its ability to study specific individuals” (Rossi and Allenby, 2005). They also point out that there exists substantial uncertainty in the part worths of a specific respondent, since they are not precisely estimated.

### 3.4 Loss averse/gain seeking behavior in demand

We consider the reactions in relative demand resulting from changes in the reference price. Since the choice behavior of a customer is explicitly included in the estimation, comparisons of changes in the expected demand or purchase probability are also a natural criterion to identify loss averse/gain seeking behavior in demand (instead of in value). If the demand decrease in case of a price above normal price level is greater than

the demand increase under a price level that is an equal amount below normal price, then the price response effect is loss averse in demand, while in the opposite case the effect is gain seeking in demand. With the multinomial logit as the choice model it turns out that definitions based on value and on demand are different; for instance, loss aversion in value may appear simultaneously with gain seeking in demand when the multinomial logit choice model is applied. In other words, to identify loss averse price response behavior in demand it is not sufficient to observe loss aversion in value. The issue is discussed in depth by Kallio and Halme, 2009. In the sequel, loss averse/ gain seeking behavior refers to loss averse/ gain seeking in demand if not otherwise indicated

## 4. Results

How the changed prices affect demand in the different services is described next. We assume that in each choice situation the three services are in the set of alternatives, with two services on the reference price level and the price for one service is changed at a time. The results are based on the calibrated value functions of individual respondents.

The estimation was carried out with HB/CBC 3.2 (Sawtooth Software). The interaction effect between delivery type and price was significant in the aggregate model (chi-square test,  $p < 0.001$ ) and the term was included in the model. As for the fit, the  $rlh$  was 0.65 with unconstrained estimation of the utilities and slightly lower (0.63) when the price levels of each respondent were constrained to have the natural signs with prices below and above normal price. The hold-out tasks permitted us to calibrate the parameter of the multinomial logit model as  $q = 0.9$ .

The relative demand for each service was next calculated using (4). Each time the demand was calculated, the market was assumed to consist of the three services and only their prices varied. In the base case, all the services have the normal price. Then the price of one service at a time is changed. The multinomial logit (4) is used to calculate for each respondent the probability to choose each service profile among the profiles offered representing the three services, two having the normal price and one having a +50 % or -50 % change in the normal price. This probability to choose a profile also represents the expected value of the profile's relative demand in a repeated simulation, when the market alternatives are the profiles offered (this type of sensitivity analyses is also conducted by Agarwal, 2002). In Table 1 the relative demand for each service is presented with three different prices.



Service	Reference price (base case)	Price + 50 %	Price – 50 %
Service1	49.5 (1.3)	38.2 (1.3)	52.9 (1.3)
Service2	34.6 (1.4)	24.8 (1.2)	46.2 (1.4)
Service3	15.9 (1.0)	11.8 (0.9)	23.7 (1.2)

Table 1. Average relative demand (%) represented by average choice probabilities (standard deviation) across respondents. The demand for each service is calculated with the normal price, price +50% and price -50% while the remaining services have the reference price. (n =1141).

When service1 takes the price above normal price, while the remaining alternatives have the normal price, its relative demand is 38.2 %. Compared with the base case the demand has fallen by 22.8 %. With its price below normal price the relative demand is 52.9 % with an increase from the base case by 6.9 %. In this case, the fall of the demand is greater than the corresponding rise.

The results for service1 support prospect theory, but the other two do not. Especially in service3, on average, a low level in price causes a considerably greater effect on the demand than the high price. Note that Table 1 could be used to calculate the price elasticity of demand – the most and least traditional services represent the extremes in behavior in such a way that service1 is the most rigid and service3 the most flexible.

Next consider the individual value functions in order to study whether or not a relative increase in price has an effect, similar in size, on the demand as a similar sized relative decrease in price. Denote the set of alternative services on the market by  $A = \{\text{service1, service2, service3}\}$ . Denote the set of respondents by  $N$ . For respondent  $i \in N$ ,  $N = \{1, \dots, n\}$ , the probability of choosing  $j \in A$  is

$P_{ji}^U$  when  $j$  has the high price and the prices of alternatives  $j' \neq j$  are unchanged

$P_{ji}^D$  when  $j$  has the low price and the prices of alternatives  $j' \neq j$  are unchanged

$P_{ji}^R$  when  $j$  has the reference price and the prices of alternatives in  $j' \neq j$  are unchanged.

Consider for  $i \in N$ ,  $j \in A$  the following variables

$$\Delta P_{ji} = (P_{ji}^D - P_{ji}^R) - (P_{ji}^R - P_{ji}^U) \quad (5)$$

If  $\Delta P_{ji} > 0$  then the low price effect is greater than the high price effect (in absolute terms).

Next test for all  $j \in A$  if the averages of  $\Delta P_{ji}$ , where

$$\Delta P_j = 1/n \sum_{i \in N} \Delta P_{ji} \quad (6)$$

are zero. The sample averages (standard deviations) and medians are presented in Table 2.

Service	$\Delta P_{\text{service}} \%$	Median %
Service1	-7.9 (1.1)	-2.6
Service2	1.8 (1.3)	0.2
Service3	3.7 (1.0)	0.1

Table 2. Sample averages (standard deviations)  $\Delta P_j, j \in A$  and medians of  $\Delta P_{ji}, i \in N$  (n=1141).

The most prominent feature of the results is that only the traditional service has strong indication of loss averse behavior. Loss aversion can in fact be detected with few exceptions in the data: 10 per cent of the individual  $\Delta P$  values for service1 are greater than zero and 4 per cent exceed 1 %. The behavior towards price changes in the two other services not yet on the market calls for more detailed considerations. In Figure 1 a)-c) the distributions of  $\Delta P_{ji}, i \in N, j \in A$  are presented.

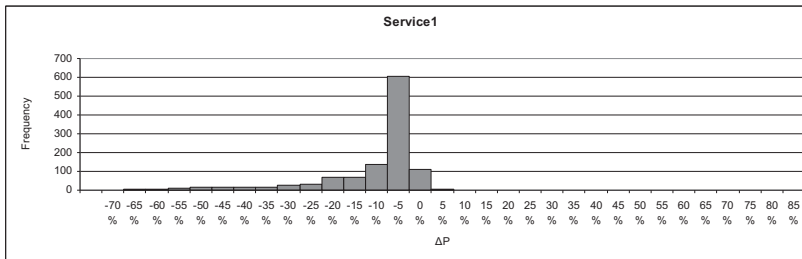


Figure 1a. Distribution of  $\Delta P_{ji}, i \in N, j = \text{service1}$ .

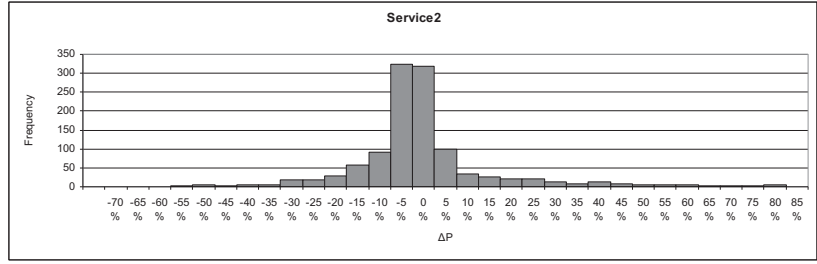


Figure 1b. Distribution of  $\Delta P_{ji}$ ,  $i \in N$ ,  $j = \text{service2}$ .

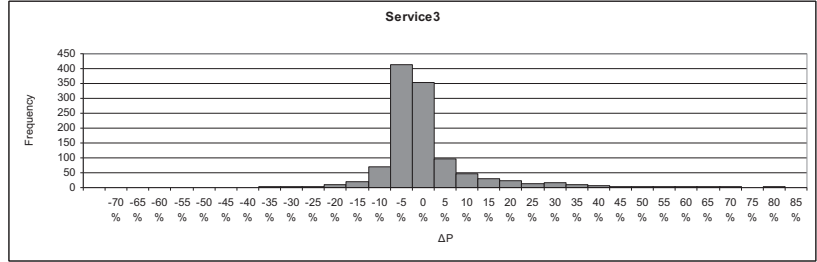


Figure 1c. Distribution of  $\Delta P_{ji}$ ,  $i \in N$ ,  $j = \text{service3}$ .

The distributions b)-c) suggest that all versions of choice behavior can be found; symmetric as well as gain seeking and loss averse.

To try and find a link between loss averse/gain seeking behavior and the sample descriptors, for each  $j \in A$ ,  $\Delta P_{ji}$  were regressed on age, relative shares of material used and educational level. The coefficients of determination of the models were very low, between 0.6 % and 2.5 %. With service2 and service3 we, however, identified significantly differing coefficients for most of the education levels indicating thus that respondents on different education levels differed in their choice behavior.

This is why, in an attempt to identify groups with lower heterogeneity than in the entire data we have produced Table 3 with the data decomposed into four education levels, as suggested by the regression results. As noted, the volume of their current use of digital material as well as familiarity with the more modern services was not equal at the time of the study. In particular the lowest and highest education levels were extreme also in their level of adoption of the new technologies.

	Level 1 (n=451)		Level 2 (n=248)		Level 3 (n=221)		Level 4 (n=221)	
	$\Delta P_{\text{service}}$	median	$\Delta P_{\text{service}}$	median	$\Delta P_{\text{service}}$	median	$\Delta P_{\text{service}}$	median
Service1	-7.9(1.6)	-2.8	-7.2(2.2)	-2.4	-8(2.2)	-2.1	-7.5(2.1)	-3.0
Service2	-0.4(1.9)	-1.0	3.8 (2.5)	0.4	1.8 (2.6)	0.8	4.3 (2.5)	1.2
Service3	4.4 (1.4)	1.0	0.5 (2.1)	1.1	6.0 (2.2)	-0.7	3.0 (2.0)	-1.2

Table 3. Sample means  $\Delta P_{j, j \in A}$  (standard deviations) and medians across four education levels (per cent).

Loss averse behavior is dominant in the traditional service1 on all education levels. On each education level the other two services show either almost symmetric or gain seeking behavior. They differ mostly with respect to the extent of gain seeking behavior. It is interesting to note that more gain seeking than loss averse behavior can be detected.

Several versions of the probability calculations were carried out to test the sensitivity of the results, such as modifications in the value function estimation and the choice rule. The results were quite robust to changes.

## 5. Discussion and conclusions

Choice behavior around the reference price for a service was studied. The data was stated preferences, originating from a choice based conjoint study where individual value functions were estimated. We could find clear differences in the choice behavior when price levels were changed for traditional service compared with the more modern services. The main outcome of the study was that strong evidence of loss aversion in demand in the traditional service was found, whereas much more versatile reactions to the changing prices in the modern services were detected as also in a number of studies referred to in Section 2. Specifically, with the more modern services a remarkable number of respondents could be diagnosed as gain seeking in demand.

The studies that study loss averse/gain seeking price behavior are all in the field of products and thus we lack benchmarks in the field of services with which the results should be compared. As mentioned, compared with grocery products the purchasing of the services is much less frequent. The services studied, however, do not include the typical unique characteristics of services even if they are intangible, and though services 2 and 3 were non-existing the teachers had well-defined perceptions of them as analogies of the existing service. In our case, the formation of the reference price was also exceptional: even the price of the existing service was not familiar for the teachers as the Ministry of Education provided the service for the schools. Thus we provided the respondents cues whether the price level was normal, above normal, or below normal. However, the role of the teachers as future active buyers of the services was going to change, which was one of the motivations for our study.

At least two important factors can be seen in the background when assessing the observed reactions to the different prices of modern service2 and service3: that they are not as easily available as the old technology and their considerably higher reference price. The only existing price was the reference price of service1 (4 €/ student per year) which could be considered as a benchmark. The lowest prices of service2 and service3 considered (3 € for service 2 and 5 € for service3) approach that benchmark price. This could be a partial explanation to the gain seeking behavior

observed among a subset of respondents; the fact that for both service2 and service3, on average, a decrease in price seemed to matter more than an increase.

The modern services may be considered as new technology and of high quality compared with the traditional techniques. Hankuk and Aggarwal (2003) stated that the quality may affect the attitude towards price changes. Like the current study, they also found that less loss averse behavior takes places in high quality tiers than low quality tiers. However, contrary to the most usual cases, in this study most of the respondents preferred the traditional technique to the more modern and higher-quality ones.

The new technology evaluated in the study is today more familiar to the respondents and their user skills more developed than in 2005. One might consider re-measurement of the price reactions of service2 and service3. Would their  $\Delta P$  distributions show more loss averse behavior compared with the situation in 2005?

The reference price studies so far have concerned low-involvement consumer products and identified mixed consumer behavior around reference price. This study shows that consumer behavior around reference price may also be mixed for a service in a market much like a b-to-b market. We expect that they expand to other product and service categories and also to b-to-b choices. It seems that the intangibility of a service and a different purchase process in a b-to-b context are not the main drivers of consumer response to reference price. Instead, we found that service novelty and consumer characteristics (educational level) influence the consumer response to reference price.

Our study also showed that conjoint analysis is a sound method to study consumer behavior around reference price. Compared to analysis of scanner panel data conjoint analysis offers a much wider area for applications. Conjoint analysis may be used to study basically any type of product or service e.g. new and existing products and services in any context. Furthermore, the incentive aligned conjoint analysis has increased the predictive power of conjoint analysis (Ding, Grewal & Liechty, 2005). Discrete choice methods enable the analysis as frequent purchases take place only in some product/service categories. The progress in estimation techniques has made it possible to reliably estimate also the individual (with scanner data the household specific) models (e.g., Klapper et al., 2005, and Terui and Dahana, 2006), as was done in the current study, and try and relate the mixed (symmetric, loss averse and gain seeking) consumer behavior around reference price e.g. to some socio-demographic descriptors.

Furthermore, this study highlights the difference in studying loss aversion in value and in demand. Even when consumer value function is loss averse, the existence of loss aversion in demand is not self-evident (Kallio & Halme, 2009). From a company's point of view it is more interesting to study the consumer reference price response in demand rather than in value. Therefore, the future research should also emphasize on studies on consumer reference price response on demand.

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Educational Level	n	Age (mean)	Use of AV material (%)	Use of printed material (%)	Use of commercial Internet (%)	Use of free Internet (%)
Primary and secondary schools	451	43.7	20.8	57.9	1.9	19.4
Colleges	248	46.0	14.8	56.8	2.3	26.1
Higher vocational schools	221	46.5	10.9	57.7	4.3	27.1
Universities	221	41.3	7.7	62.2	7.4	22.7
All	1141	44.3	15.0	58.5	3.5	23.0

Appendix 1. Sample description

You have at your disposal free Internet services. You wish to distribute the content to your students to supplement your teaching. .

Choose the alternative best suited for you by clicking the ball in the lower part of the card.

**Website:**  
Communication material  
of companies and public  
administration

**Usage:**  
Scanning into Power  
Point

**Price:**  
9 euros per year/student  
(above normal)



**Website:**  
Scientific material

**Usage:**  
Copying and delivery in  
Intranet

**Price:**  
5 euros per year/student  
(below normal)



**Website:**  
Educational material of  
educational institutions

**Usage:**  
Printing for students

**Price:**  
4 euros per year/student  
(normal)



Appendix 2. Example of a choice task.

Type of Internet material	
1. publishers' open educational material websites 2. educational material by educational institutions 3. news; e.g. articles and websites 4. scientific material from universities and research institutes 5. pictures; photographs, drawings, maps 6. communications of companies and public administration; instructions, product and service information	
Type of reproduction	
1. printing/copying to students 2. copying into own presentation, e.g. Power Point 3. delivery to students in school Intranet or email	
Price, price was dependent on type of usage	
printing/copying to students	1. 4 €, normal 2. 6 €, 50 % above normal 3. 2 €, 50 % below normal.
copying into own presentation, e.g. Power Point	1. 6 €, normal 2. 9 €, 50 % above normal 3. 3 €, 50 % below normal.
delivery to students in school Intranet or email	1. 10 €, normal 2. 15€, 50 % above normal 3. 5 €, 50 % below normal.

Appendix 3. Values of attributes employed.

The study was distributed to the teachers included in the sample in fall 2005. At the time all the educational levels had a collective license that allowed photocopying and printing. The license was provided to the schools by the Ministry of Education. In Finland, teachers typically have a small budget to purchase some teaching materials in addition to school books, e.g. newspapers or digital material. In a business school typically bought materials are Harvard cases. The photocopying license allowed teachers to photocopy material and the fee is paid in advance by the Ministry of Education. For digital copying no such licenses were effective in 2005 and no such licenses existed in 2010. If a teacher wants to use some material he/she has to ask permission from a copyright owner/publisher and possibly pay for the use.

For digital copyright licenses the markets were expected to change from this collective system. Instead of the Ministry of Education purchasing a collective license to all schools, it may be that schools and teachers buy individually own copyright licenses. This would change the teacher's role as a purchasing decision maker significantly.

In the study, on the screens preceding the preference elicitation tasks it was instructed that the respondents should not pay any attention if the product profiles evaluated were not in the market. They were instructed to think "what is a fair price for the services".

Copyright license selling organization	Country	License terms	License price	Comments
The Copyright Licensing Agency, CLA	United Kingdom	Includes photocopying and scanning for primary and secondary education	£ 0,89 per primary pupil in state school  £ 1,47 per secondary pupil in state school	The price difference between the two license type are due to differences in copying terms and copying volumes.
		License allowing photocopying, scanning and digital copying for Higher Education	£ 6,44 per full time student in state university	
Copyright organization, CCC	USA	Photocopy of journal for academic coursepack or classroom handouts	\$ 0,20 per page	This is only one example of fee. The copyright holders set individually the fee for copyright license of his/her work.
		Deliver material via e-mail	\$ 7 / one student  \$ 83 / 20 students	

Appendix 5. Price comparison of different copyright licenses (2009).





# Essay III

Somervuori Outi and Ravaja Niklas: Purchase Behavior and Psychophysiological Responses to Different Price Levels.



# **Purchase Behavior and Psychophysiological Responses to Different Price Levels**

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## **Abstract**

The aim of the study was to examine emotional processes when product prices for different brands are changed. In a within-subjects design, the participants were presented purchase decision trials with 14 different products (7 private label and 7 national brand products) whose price levels were changed while their facial electromyography (EMG) and electrodermal activity (EDA) were recorded. The results suggest that low prices and national brand products induce higher positive emotions indexed with zygomatic EMG compared to high prices and private label products. Also, positive emotions are related to greater purchase intent. Naturally, a low price has also a direct positive influence on purchase intent. However, the involvement of emotions and the influence that price and brand have on elicitation of emotions may be one explanation for consumers' varying purchase behavior. The results highlight the importance of emotional factors in pricing research and support the usefulness of psychophysiological measures in the consumer research.

Keywords: price, emotions, psychophysiological measures, electromyography (EMG), electrodermal activity (EDA)

# 1. INTRODUCTION

The reference price concept and how consumers react to price changes from a reference price has been widely studied in economics and marketing. This information is important for companies in planning pricing strategies and timing pricing changes.

Prospect Theory, introduced by Kahneman and Tversky (1979), suggests that consumers react more to losses (price increases) than to gains (price decreases). The phenomenon has been extensively studied by statistically modeling scanner panel data of frequently purchased grocery products. However, empirical results are mixed; some concluding that consumers are more responsive to losses and others that consumers are more responsive to gains, while some studies report symmetric behaviour (Bell & Lattin, 2000; Mazumdar & Papatla, 1995; Putler, 1992; Terui & Dahana, 2006).

Our study will extend the research on the discussion above. Our aim is not only to look at the behavior around reference price (normal selling price) but also to understand the emotional responses elicited by low and high prices, and brand. In this study we apply psychophysiological measures to study the emotional responses.

Even though recent research on emotions has identified, for example, that emotions have a significant role in decision making (Vohs, Baumeister, & Loewenstein, 2007), the current pricing literature has paid only limited attention to the role emotions play in how people respond to prices and price information. One reason for the lack of research on emotions and pricing is that researchers have been forced to rely on self-reports and observed behavioral measures. These methods may be inadequate because they rely on respondents' ability to describe and reconstruct emotions and thoughts, or on observers' ability to identify the emotions. Many of the emotions may be perceived non-consciously hence the cognitive filter of the test taker may bias the results. In addition, respondents' strategic behavior and social desirability can confound the findings (Hubert & Kenning, 2008).

The advent of psychophysiological measures in psychology has made it possible to include reliable measures of emotions also in pricing research. Psychophysiological measures can potentially add a new dimension to our

understanding of emotional processes – a dimension that we cannot necessarily tap if we only record behavioral responses. Their use may lead to a more complete and objective understanding of consumer desires, and may consequently assist companies to adjust their strategies.

Previous literature in consumer research includes a few studies that have applied psychophysiological and neurophysiological methods. For example, Groeppel-Klein (2005) recorded consumers' electrodermal activity (EDA) at the point-of-sale, the results suggesting that arousal is an important construct for the explanation of buying behavior. Studies using psychophysiological methods have also been carried out in the area of media research (Ravaja, 2004). The fMRI studies have shown the advantages of this method in studying consumer behavior related to brands and price; for example, activation of distinct brain circuits may be used to predict purchases (Knutson, Rick, Wimmer, Prelec, & Loewenstein, 2007), different types of brands activate different brain areas (Esch et al., 2010), celebrity products pairings increase the activity of the medial orbitofrontal cortex (mOFC) that has been associated with the encoding of the subjective liking (Stallen et al., 2010), and a high price compared to a low price in the same wine increases the subjective reports of flavor pleasantness as well as blood-oxygen-level dependent activity in medial orbitofrontal cortex that is considered to encode experienced pleasantness (Plassmann, O'Doherty, Shiv, & Rangel, 2008).

However, the previous studies have not studied consumer purchase behavior for different brands when price level is changed. The present research was conducted as a laboratory experiment where participants performed purchasing tasks for 14 different products (7 private label and 7 national brand products) whose prices were changed. While the participants performed the purchasing tasks, their facial EMG and EDA were recorded.

This study consists of four main sections. First, the theoretical background of the research is discussed. Then, research methods and data collection are described, followed by results section. In the final section, the results are discussed and concluded.

## 2. THEORETICAL BACKGROUND

In this section, we will first look at previous literature on demand reactions to different price levels for private label and national brand products. Next, we will discuss the role of emotions in purchase decision and last the role of emotions on price and brand.

### 2.1 Demand Reactions to Different Price Levels for Private Label and National Brand Products

Majority of marketing discussion related to demand reactions in response to different price levels discusses the impact of price decreases, and asymmetric effects of price increases and decreases. The research almost unanimously agrees that the price decreases in higher quality brands attract more consumers than do price decreases in lower quality brands (Allenby & Rossi, 1991; Blattberg & Wisniewski, 1989; Bronnenberg & Wathieu, 1996). Brands are frequently divided into low- and high-quality tiers. Brands in high-quality tiers may offer comfort, security, and value while brands in low-quality tiers may offer lower prices, but lower quality too (Hankuk & Aggarwal, 2003). Several researchers have classified private-label brands in the low-quality tier (Hankuk & Aggarwal, 2003).

The discussion on price promotion effects suggests that consumers react also more strongly to price decreases for national brand products than for private label products. Therefore, our first hypothesis is:

**H1:** The demand will increase faster for national brand products compared to private label products as the price level decreases.

Reference price and loss aversion has its roots e.g. in prospect theory (Kahneman & Tversky, 1979). Prospect theory defines a value function over gains and losses from a reference point. The idea in pricing context is that a price increase from a reference point represents “loss” and a price decrease from a reference point represents “gain”. According to prospect theory the individual value function is asymmetric from reference point and the

function is steeper for losses than for gains in the neighbourhood of the reference point (a phenomenon called loss aversion).

Many of the studies in this area statistically model scanner panel data and define loss aversion on the basis of changes in perceived value (Bell & Lattin, 2000; Hardie, Johnson, & Fader, 1993; Krishnamurthi, Mazumdar, & Raj, 1992; Mazumdar & Papatla, 1995; Putler, 1992). This approach to studying consumer choice around reference prices has resulted in mixed results. Some of the studies have discovered effects supporting loss aversion (Hardie et al., 1993; Kalyanaram & Winer, 1995; Kalwani, Yim, Rinne, & Sugita, 1990; Mayhew & Winer, 1992; Putler, 1992; Terui & Dahana, 2006)). The other set of studies identified symmetric, loss aversive and gain seeking results (Bell & Lattin, 2000; Erdem, Mayhew, & Sun, 2001; Klapper, Ebling, & Temme, 2005; Krishnamurthi et al., 1992; Mazumdar & Papatla, 1995). For example, Klapper et al. (2005) found that non-quality conscious consumers exhibit loss aversion and quality conscious exhibit less loss aversion. Hankuk and Aggarwal's (2003) experiment on high and low quality-tier products identified that loss aversion occurred only with low quality-tier products. Consumers showed gain seeking behavior towards products that have high quality-tiers.

Our study will extend the research on the discussion above. However, our study differs from the earlier work significantly since we will not use scanner data. Instead, the data are obtained from an experiment where the respondents participate in a purchasing task. Prospect theory considers changes in value from a reference point. However, we look at the changes in demand from product's normal selling price (normal price). We consider that from management point of view, the changes in demand from a normal price are more interesting parameters. Therefore, our aim is not to reflect the results on Prospect Theory, but rather to look at the impact of different price levels on purchase decisions.

**H2:** The changes in demand around normal price will be asymmetric and the participants will show more loss aversive behavior towards private label products compared to national brand products.

## **2.2 Purchase Behavior and Emotions**

Emotions can be defined as biologically based action dispositions that play an important role in the determination of behavior (Lang, 1995), for example emotions have a significant role in decision making (Vohs et al., 2007).

A dimensional theory of emotion holds that all emotions can be located in a two-dimensional space, as coordinates of valence and arousal (or bodily activation; Lang, 1995; Larsen & Diener, 1992). The valence dimension refers to the hedonic quality or pleasantness of an affective experience, and ranges from unpleasant to pleasant. The arousal dimension indicates the level of activation associated with the emotional experience, and ranges from very excited or energized at one extreme to very calm or sleepy at the other. According to Havlena and Holbrook (1986), the dimensional theory captures more information about the emotional character of consumption experience than does a categorical approach (separate basic emotions, such as anger, disgust, fear, happiness, sadness, and surprise).

However, some theorists have suggested that the two main, orthogonal dimensions of emotional experience are negative activation (NA) and positive activation (PA) that represent a 45° rotation of the valence and arousal axes (Watson & Tellegen, 1985; Watson, Wiese, Vaidya, & Tellegen, 1999). The NA axis extends from highly arousing negative emotion (e.g., fear and anger) on one end to low-arousal positive emotion (e.g., pleasant relaxation) on the other, while the PA axis extends from highly arousing positive emotion (e.g., joy, enthusiasm) to low-arousal negative emotion (e.g., depressed affect; figure 1). Negative activation is associated with avoidance or inhibition while positive activation is related to approach motivation, including higher purchase intent (Andrade, 2005; Frijda, 1986).

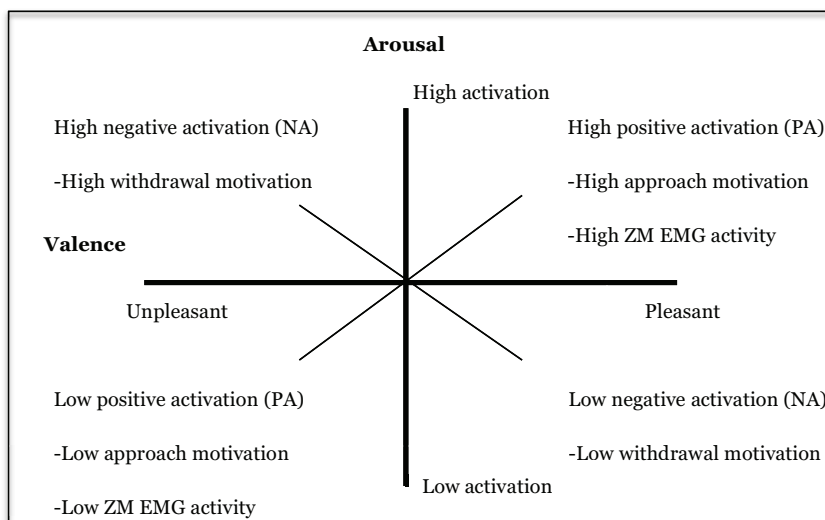


Figure 1. A schematic for the two-dimensional structure of affect. Adapted from Larsen and Diener, 1992; Ravaja, 2004.



The facial electromyography (EMG) provides a direct measure of the electrical activity associated with facial muscle contractions that are an important form of emotional expression (Tassinari & Cacioppo, 2000). A number of studies have shown that processing pleasant emotions prompts greater activity over the zygomaticus major (cheek) muscle region during affective imagery (Ravaja, Saari, Kallinen, & Laarni, 2006; Witvliet & Vrana, 1995) and when presented with affective still and moving images (for 6 s, Lang, Greenwald, Bradley, & Hamm, 1993; Lang, 1995; Simons, Detenber, Roedema, & Reiss, 1999), written words (Larsen, Norris, & Cacioppo, 2003), 60-s radio advertisements (Bolls, Lang, & Potter, 2001), video news messages (Ravaja, Kallinen, Saari, & Keltikangas-Järvinen, 2004; Ravaja et al., 2006), and textual news messages (Ravaja et al., 2006). There is also evidence that zygomatic EMG responses are most parsimoniously organized along the PA dimension (Larsen et al., 2003; Heponiemi et al., 2006). Given that high PA is associated with approach tendency, zygomatic EMG activity can be used to index approach motivation. That being so, our third hypothesis is:

**H3:** Increased zygomatic activity (increased positive emotions) during seeing an image of a product will predict the decision to purchase the product.

Electrodermal activity (EDA), commonly known as skin conductance, is an important psychophysiological index of arousal and is innervated entirely by the sympathetic nervous system (SNS; Dawson, Schell, & Filion, 2000). Several studies using the picture-viewing paradigm have shown that EDA is highly correlated with self-reported emotional arousal (Lang et al., 1993). Given that high approach motivation and enthusiasm elicited by preferred products are accompanied by high arousal, our next hypothesis is:

**H4:** Increased EDA (increased arousal) during seeing an image of a product will predict the decision to purchase a product.

## **2.3 Price, Brand and Emotions**

The current pricing literature has paid only limited attention to the role emotions play in how people respond to prices and price information. A few exploratory studies suggest, however, that emotions may have an important role in price perception (Honea & Dahl, 2005; O'Neill & Lambert, 2001; Peine, Heitman, & Herrmann, 2009). O'Neill and Lambert (2001), for

example, suggest that as involvement in a product category increases, positive emotions with price increases. In addition, enjoyment correlates positively with price-quality perception. In their experiment, Peine et al. (2009) found that participants reported more negative price affect and less positive price affect in the high-price condition than in low-price condition.

Therefore, our fifth hypothesis is:

**H5:** Price level of a product will be inversely associated with zygomatic EMG activity (positive emotions).

Recent neuroscience research suggests that also brand may emotionalize the purchase decision (Deppe et al., 2005; Schaefer, Berens, Heinze, & Rotte, 2006). For example, consumers' favorite brand (Deppe et al., 2005) and brand familiarity (Schaefer et al., 2006) increased the activation in the brain areas involved in the processing of emotions. Given the earlier discussion on differences between private label and national brand products, we expect that emotional processes may be stronger for national brand products than for private-label products. This leads to the following hypothesis:

**H6:** National brand products will be associated with higher zygomatic EMG activity (higher positive emotions) compared to private label products.

### 3. METHODS

The research was conducted as a laboratory experiment. The idea in the experiment was to study participants' purchase behavior and psychophysiological reactions when a product's price levels were changed for national brand and store labeled products in seven different product categories.

*Participants.* Altogether 33 right-handed healthy business students (14 males and 19 females) participated in the experiment, who ranged from 20 to 44 years of age ( $M = 27.0$ ). All participants were responsible for their own household's grocery purchases. The participants received 40 € in cash to spend on products during the experiment. In return for their participation, the participants could keep the purchased products and that part of the endowment they had not spent when leaving the experiment.

*Design.* A  $7$  (Product Category)  $\times 2$  (Brand)  $\times 15$  (Price) within-subjects design was employed. Seven product categories were selected for the research: detergent, chocolate, coffee, chips, orange juice, chocolate cookies, and toothpaste. Seven products were considered enough to assure participant interest to many product categories even though some participants wouldn't like some particular categories.

For each product category, two products were selected: one national brand product and one store labeled product (altogether 14 different products). Such national brand and private label products from each product category were selected that had as similar trade description as possible. The selected national brand products were the market leaders of that product category. A corresponding product was selected from the private label category.

The third variable, the price, included 15 different price levels plus one duplicate for the normal price level to control the participant consistency. Altogether, each product was presented 16 times (16 trials). Each product's selling price at a local supermarket was selected as a normal price level. The prices varied from normal price level  $\pm 3\%$ ,  $6\%$ ,  $10\%$ ,  $25\%$ ,  $40\%$ ,  $60\%$ , and  $75\%$ . Since each product has an individual normal price level, a

variable called price multiplier presents the different price levels for each product. The levels of price multipliers are 0.25, 0.4, 0.6, 0.75, 0.9, 0.94, 0.97, 1, 1.03, 1.06, 1.10, 1.25, 1.4, 1.6, 1.75 (1=product's normal price, 0.25=normal price minus 75%, 1.75=normal price plus 75% etc.) List of all products and their all price levels are presented in Appendix A. The 224 trials were presented in a random order to avoid order effects.

*Procedure.* In the laboratory, the participants were first given instructions on the task and tested for task comprehension. The participants were asked to imagine them grocery shopping in a local supermarket and having 40 € to spend (their endowment). In each trial, they were shown a picture of a product with a price and they were asked whether they want to buy the product or not. All participants were presented with 224 trials in a random order. To ensure the participant's engagement in the purchasing task, one trial for each product was randomly selected to count for real (participants were informed about this in the beginning of the experiment). If the participant had chosen to purchase the product in the randomly selected trial, they paid the price shown in the trial from their endowment and were given the product with them. If they had chosen not to purchase the product, they could keep their endowment. In addition, participants were introduced a bonus schema where they were able to gain additional 5 € bonus if they answered "yes" for more than 30 % of the trials.

The experiment seeks to simulate normal shopping situation taking into account the disadvantages of laboratory environment. Participant engagement was critical to ensure elicitation of psychophysiological reaction therefore real money was given to participants and real products were purchased. In addition, the participants were well motivated to relieve their true willingness-to-pay (WTP) for all products since only one trial out of each product was randomly selected to count for real. Participants were motivated not to underestimate the WTP since in a lottery there is a risk of regret of not being able to purchase a product with good price if WTP is underestimated. On the other hand, since the participants had to pay real money the participants would not overestimate their WTP either. The sufficiently large number of products ensured that all participants were interested in many products. The fact that all participants were not interested in all products corresponds to a normal market situation. Local grocery stores also have similar bonus schemas as introduced in the experiment. Typically, in the end of each month/year, each grocery store delivers some bonus back to their customers. Therefore, the bonus is not assumed to create un-normal behavior. In addition, the bonus schema balances out the de-motivational aspects of laboratory setting.

To avoid learning effect the trials were presented in a completely random order. Since there were a large number of trials and no indication whether the price shown was normal, low or high, the participants were not able to learn the pricing structure to form strategic behavior. In addition, the statistical tests indicated that the trial order did not have significant influence on purchase behavior.

After the briefing, the participant filled out an informed consent form. Electrodes were then attached, and the participant was seated on a chair. The participant was left alone in the laboratory for a 7-min rest period, followed by the experiment that took, on average, 52 minutes. The participants were instructed that after each trial they would see a question whether they want to purchase the product or not, and they should choose Y for yes and N for no.

After finishing with all trials, the electrodes were removed, and the participant was debriefed and thanked for participation.

*Trials.* Each of the 224 trials consisted of the following phases: (a) a fixation cross on a screen presented for 1 s to focus the attention of the participant to the middle of the screen (fixation period), (b) an image of a product with a price shown for 6 s, (c) a prompt on the screen to choose either to purchase the product or not by selecting either Y for yes or N for no (decision phase ended when the participants made the selection), and (d) an interstimulus interval varying randomly from 7 to 9 s while the screen was black. The trials were presented using Presentation 10.4 software.

*Psychophysiological Data Collection.* Facial electromyographic (EMG) activity was recorded from left zygomaticus major (ZM) muscle areas as recommended by Fridlund and Cacioppo (1986), using surface Ag/AgCl electrodes with a contact area of 4 mm diameter (MED Associates Incorporated, St. Albans, VT). Electrodes were filled with TD-240 electrode gel. The raw EMG signal was amplified, and frequencies below 30 Hz and above 400 Hz were filtered out, using the Psylab Model EEG8 amplifier. The raw signal was rectified and integrated using the Psylab INT8 contour following integrator (time constant = 50 ms).

Electrodermal activity was recorded with the Psylab Model SC5 24 bit digital skin conductance amplifier that applied a constant 0.5 V across Ag/AgCl electrodes with a contact area of 8 mm diameter (Med Assoc. Inc., St. Albans, VT). Electrodes were filled with TD-246 skin conductance electrode paste (Med Assoc. Inc.) and attached to the middle phalanges of

the first and second fingers of the participant's non-dominant hand after hands were washed with soap and water.

The data collection was controlled by Psylab7 software, and all physiological signals were sampled at a rate of 500 Hz.

*Data Analysis.* For each trial, mean values for facial EMG and EDA were derived for the 6-s epoch when the picture of a product with a price was presented and for a 5-s epoch preceding picture onset (i.e., local baseline). Delta scores for facial EMG and EDA were formed by subtracting the baseline physiological value from the mean value during picture presentation.

All data were analyzed using the Generalized Estimating Equations (GEE) procedure in SPSS. In the GEE procedure, the dependent variable is linearly related to the factors and covariates via a specified link function. The model allows for the dependent variable to have a non-normal distribution and covers widely used statistical models (e.g., logistic models for binary data). The GEE procedure extends the generalized linear model to allow for analysis of repeated measurements or other correlated observations. The GEE approach requires the specification of the correlation structure of the repeated observations of the dependent variable, distribution of the dependent variable, and link function. The GEE models were introduced by Liang and Zeger (1986), and the method has received wide use in medical and life science research (Ballinger, 2008).

When predicting purchase decisions, the model included the main effects of brand, product category, price multiplier, product's normal selling price, zygomatic EMG delta scores, and EDA delta scores as well as the Brand  $\times$  Price Multiplier interaction. We specified binomial distribution, exchangeable correlation matrix, and logit as the link function.

In addition, we examined whether the association of price with purchase behavior is different when the price is below a normal price compared to when it is above a normal price. A dichotomous variable that indicated whether the price was above or below a normal price was formed. In addition, the price multiplier was centralized (normal price = 0). The GEE model included the main effect of product category, centralized price multiplier, and the interaction between the price increase/decrease indicator and centralized price multiplier. This approach is similar to a piecewise regression (McGee & Carleton, 1970). In this analysis, we also specified binomial distribution, exchangeable correlation matrix, and logit as the link function. The analysis was done separately for private label and national brand products.

Furthermore, we modelled the predictors of zygomaticus major EMG activity (index of positive emotions). The zygomaticus major EMG value during the picture presentation was the dependent variable. The model included the main effects of baseline zygomaticus major EMG (a control variable), brand, product category and price multiplier. We specified normal distribution, unstructured correlation matrix, and identity as the link function.

## 4. RESULTS

In 38% of the trials ( $n = 224$ ), the participants chose to purchase the product and, in 62% of the trials, not to purchase the product. The frequency of purchases varied across product categories and brands. The results of the GEE analyses for purchase decision are shown in table 1. The piecewise GEE analyses are presented in table 2 and the results of the GEE analysis for zygomaticus major EMG responses are shown in table 3. Figure 2 shows the average number of purchases for all national brand and private label products by price multiplier. The results showed that price level (price multiplier) influenced purchase decision,  $p < .001$ . That is, the higher the price multiplier was (high price level), the less products were purchased. The brand also influenced purchase decision, the participants were more likely to purchase a product if it was private label,  $p < .001$ .

Source		B	SE	Wald $\chi^2$	df	Sig.
Model 1						
Intercept		6.20	.73	69.56	1	<.001
Zygomaticus major		.06	.25	6.25	1	.012
EMG						
EDA		.10	.13	.54	1	.463
Brand		-	-	34.70	1	<.001
Product category		-	-	35.57	6	<.001
Price multiplier		-5.23	.49	146.43	1	<.001
Normal price		-1.02	0.18	30.39	1	<.001
Brand × Price Multiplier		-	-	46.52	1	<.001

Table 1. Results of generalized estimating equations (GEE) analysis of purchase decision.

*Hypothesis 1* predicted that the demand will increase faster for national brand products compared to private label products as the price level decreases. In agreement with hypothesis 1, there was a significant Brand × Price Multiplier interaction,  $p < .001$  (table 1). Figure 2 shows that the demand function (average number of purchases) is steeper for national



brand products than it is for private label products, meaning that the participants purchased relatively more national brand products when national brand product price levels decreased. That being so, the hypothesis was confirmed.

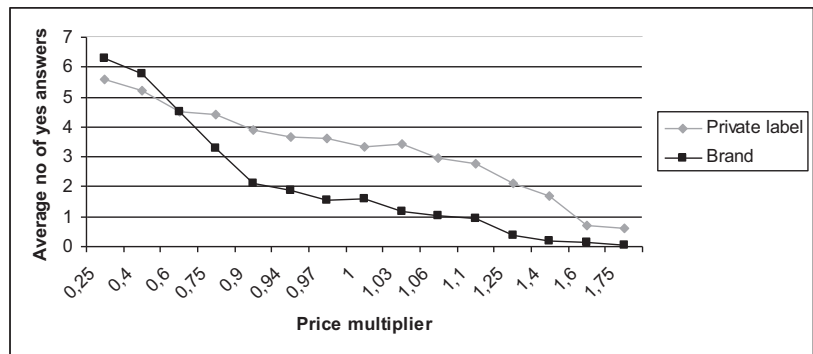


Figure 2. Average number of purchases for private label and national brand products by price multiplier

*Hypothesis 2* suggested that the changes in demand around normal price will be asymmetric and the participants will show more loss averse behaviour towards private label products compared to national brand products.

Figure 2 shows that, as expected, the changes in demand around normal price were asymmetric. The piecewise GEE showed a significant interaction between centralized price multiplier and the price increase/decrease indicator for both private label and national brand products,  $\chi^2 = 11.22$  and  $4.07$ ,  $p = .001$  and  $.044$ , respectively (table 2). The demand for private label products was loss averse, given that the demand decreased relatively more as the price level increased,  $B = -3.24$ ,  $SE = .29$ , than the demand increased as the price level decreased,  $B = -2.02$ ,  $SE = .27$ , reference price being the store normal selling price. In contrast, for national brand products, the participants were more responsive in terms of demand to price level decreases,  $B = -5.42$ ,  $SE = .52$ , compared to price level increases,  $B = -4.02$ ,  $SE = .66$ . The hypothesis was thus confirmed.

Source	B	SE	Wald $\chi^2$	df	Sig.
Private-label products					
Intercept	.24	.33	.04	1	.838
Product category	-	-	61.31	6	<.001
Centralized price multiplier	-	-	155.86	1	<.001
Low price levels x Centralized Price Multiplier	-2.02	.27	11.22	1	.001
High price levels x Centralized Price Multiplier	-3.24	.29	11.22	1	.001
National brand products					
Intercept	-.89	.31	20.09	1	<.001
Product category	-	-	45.79	6	<.001
Centralized price multiplier	-	-	97.27	1	<.001
Low price levels x Centralized price multiplier	-5.42	.52	4.07	1	.044
High price levels x Centralized price multiplier	-4.02	.66	4.07	1	.044

Table 2. Results of piecewise generalized estimating equations (GEE) analysis of purchase decision.

*Hypothesis 3* predicted that increased zygomatic EMG activity (increased positive emotions) during seeing an image of a product will predict the decision to purchase the product. In agreement with this hypothesis, the GEE procedure showed that zygomaticus major (cheek muscle) responses to an image of a product with price were significantly associated with purchase decision,  $p = .012$  (table 1). The higher the zygomatic responses were (i.e., higher positive affect), the more likely the participants were to purchase a product.

*Hypothesis 4* predicted that increased EDA (increased arousal) during seeing an image of a product will predict the decision to purchase a product. However, EDA (i.e., arousal) was not significantly associated with purchase behaviour (table 1). Thus, hypothesis 4 was not supported.

*Hypothesis 5* suggested that lower price levels will be associated with higher zygomatic EMG activity (higher positive emotions). In agreement with the hypothesis, price multiplier is a significant predictor for zygomatic activity,  $p < .001$  (table 3). The price multiplier is negatively associated with zygomatic activity, as the price level increase the zygomatic activity decrease  $B = -0.003$ ,  $SE = .008$  as can be seen in table 3. This means that lower pricelevels are associated with higher zygomatic EMG activity.

Source	B	SE	Wald $\chi^2$	df	Sig.
Intercept	.26	.01	368.778	1	<.001
Zygomaticus major EMG, baseline	.69	.02	900.637	1	<.001
Brand	-	-	10.140	1	.001
Product category	-	-	411.203	6	<.001
Price multiplier	-.04	.01	53.009	1	<.001

Table 3. Results of generalized estimating equations (GEE) analysis of zygomaticus major EMG responses.

*Hypothesis 6* suggested that national brand products will be associated with higher zygomatic EMG activity (higher positive emotions) compared to private label products. As shown in table 3, brand has a significant effect on zygomatic EMG activity,  $p = .001$  (table 3). National brand products elicited higher zygomatic EMG activity compared to private label,  $p < .001$ . Thus, the hypothesis 6 is confirmed.

## 5. DISCUSSION

The purpose of this study was to extend the price research by looking at what role emotions have in how people respond to prices and price changes. Until recently, experiments assessing the processing of emotions were forced to rely entirely on self-reports and observed behavioral measures. The advent of psychophysiological measures can potentially add a new dimension to our understanding since they allow us to measure emotional processes. On one hand we can measure how the emotions influence purchase decisions and on the other hand the variables that trigger elicitation of emotions. Therefore, our understanding of emotional processes affecting purchase decision can be improved. To our knowledge, no other study has previously applied these psychophysiological measures in a corresponding purchase experiment.

The research was conducted as a laboratory experiment where the participants were presented with shopping trials for 14 different products (7 private label and 7 brand products) whose price levels were varied. While the participants completed the shopping trials, their facial electromyography (EMG) and electrodermal activity (EDA) were recorded.

### 5.1 Discussion of findings

The results suggest that a low price level and national brand products elicit greater positive emotions compared to a high price level and private label products as indexed by zygomatic EMG activity. Also, positive emotions are related to a greater purchase intent. Naturally, a low price level has also a direct positive influence on purchase intent. However, private label products were purchased more than national brand products in the experiment. The involvement of emotions and the influence that price and brand have on the elicitation of emotions may be one explanation for differing behavior around reference price, for example.

The identified behavior around a reference price in our study supports some of the previous findings that consumers react more strongly to price decreases of national brand products compared to private label products (Bronnenberg & Wathieu, 1996) and that consumer behavior around a

reference price is mixed (Halme & Somervuori, 2009; Hankuk & Aggarwal, 2003; Klapper et al., 2005). Our experiment highlights that not only low price levels but also high price levels have a larger effect on demand for national brand products compared to private label products. That being so, all price changes are more critical for national brand products than for private label products. In addition, the results indicate that the consumer purchase behavior around a normal price is more gain seeking for national brand products, whereas it is more loss aversive for private label products. This information is useful, for example, in planning price communication messages.

To better understand the varying behavior, we considered the direct influence that emotions have on purchase decision and the influence that price and brand has on the elicitation of emotions. We found that increased zygomatic EMG activity (an index of positive emotions and approach motivation) predicted an affirmative decision to purchase a product. However, emotional arousal as indexed by EDA did not have a significant impact on purchase decision. In this study, this may be due to the low value of items purchased (the average price of products was 1.72 €) as previously EDA has been found to be an important construct for the explanation of buying behavior (Groepel-Klein, 2005).

When we looked at the elicitation of zygomatic EMG activity, we found that low prices elicit significantly more zygomatic EMG activity than high prices. Peine et al. (2009) had similar finding in their research where participant in self-reports expressed that a price increase led to changes in price affect. In our study, the increased zygomatic EMG activity was greater for national brand products than for private label products. As brand products are seen to provide comfort, security and value (Hankuk & Aggarwal, 2003) the greater emotional attachment seems natural.

Price and brand have also direct influence on purchase decision. The results suggest that a low price level and private label product predict affirmative purchase decision. As private label products are cheaper they may induce direct positive influence on purchase decision. However, the national brand products seem to elicit more positive emotions. It may be that via increased positive emotions/ approach motivation the reaction to price changes is stronger for national brand products than for private label products.

## **5.2 Implications**

The research results highlight the importance of emotions in purchase decisions and on the role emotions play in how people respond to prices

and price information. Prices and emotions, for example, have both a direct role on purchase decision as well as prices have influence on elicitation of emotions. In this case, a low price level has positive influence on purchase decision and on positive emotions. In addition, brand and emotions have direct influence on purchase decision and brand also influences elicitation of emotions. However, private label products seem to predict affirmative purchase decision while national brand products seem to trigger positive emotions. The involvement of emotions may explain the mixed consumer behavior. Therefore, the ignorance of emotions may lead to incorrect conclusions in consumer purchase decision estimates.

Our work is a good example of how psychophysiological measures may be applied in marketing and pricing research. The results of the experiment show that the method is sound and the new information that may be identified may be of great interest to both researchers and practitioners.

Psychophysiological methods have turned out to be useful, for example, in communication and media research. They provide a promising tool for pricing research as well. They provide important new information and empower the researchers to study new dimensions of traditional pricing problems. At the same time, there are, however, clear caveats and pitfalls in the interpretation of the research results (e.g. interpretation is dependent on the research paradigm and the content of the message). In addition, laboratory experiments in a controlled environment hold certain disadvantages. Therefore, more research in this area is needed to fully understand the psychophysiological responses and the meaning of them in the area of consumer purchase and pricing.

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Prices in EUR		Price multiplier														
Product	0.25	0.4	0.6	0.75	0.9	0.94	0.97	1	1.03	1.06	1.1	1.25	1.4	1.6	1.75	
Chips National Brand	0.65	1.04	1.55	1.94	2.33	2.43	2.51	2.59	2.67	2.75	2.85	3.24	3.63	4.14	4.53	
Chips Private Label	0.28	0.46	0.68	0.85	1.02	1.07	1.1	1.14	1.17	1.21	1.25	1.42	1.59	1.82	1.99	
Chocolate National Brand	0.42	0.68	1.01	1.27	1.52	1.59	1.64	1.69	1.74	1.79	1.86	2.11	2.37	2.7	2.96	
Chocolate Private Label	0.29	0.46	0.69	0.86	1.04	1.08	1.12	1.15	1.18	1.22	1.27	1.44	1.61	1.84	2.01	
Coffee National Brand	0.82	1.32	1.97	2.47	2.96	3.09	3.19	3.29	3.39	3.49	3.62	4.11	4.61	5.26	5.76	
Coffee Private Label	0.35	0.56	0.83	1.04	1.25	1.31	1.35	1.39	1.43	1.47	1.53	1.74	1.95	2.22	2.43	
Cookie National Brand	0.41	0.66	0.99	1.23	1.48	1.54	1.59	1.64	1.69	1.74	1.81	2.05	2.3	2.63	2.87	
Cookie Private Label	0.26	0.42	0.63	0.79	0.95	0.99	1.02	1.05	1.08	1.11	1.16	1.31	1.47	1.68	1.84	
Detergent National Brand	0.7	1.12	1.67	2.09	2.51	2.62	2.71	2.79	2.87	2.96	3.07	3.49	3.91	4.46	4.88	
Detergent Private Label	0.33	0.53	0.79	0.98	1.18	1.23	1.27	1.31	1.35	1.39	1.44	1.64	1.84	2.1	2.3	
Orange juice National Brand	0.74	1.18	1.77	2.21	2.66	2.77	2.86	2.95	3.04	3.13	3.25	3.69	4.13	4.72	5.16	
Orange juice Private Label	0.16	0.26	0.39	0.49	0.59	0.61	0.63	0.65	0.67	0.69	0.72	0.81	0.91	1.04	1.14	
Toothpaste National Brand	0.44	0.7	1.05	1.31	1.58	1.64	1.7	1.75	1.8	1.86	1.93	2.19	2.45	2.8	3.06	
Toothpaste Private Label	0.17	0.26	0.4	0.5	0.59	0.62	0.64	0.66	0.68	0.7	0.73	0.83	0.92	1.06	1.16	

Appendix A. List of all products and their price levels

## Essay IV

Ravaja Niklas, Somervuori Outi and Salminen Mikko: Predicting Purchase Decision: The Role of Hemispheric Asymmetry over the Frontal Cortex, forthcoming in Journal of Neuroscience, Psychology and Economics.



# Predicting Purchase Decision: The Role of Hemispheric Asymmetry over the Frontal Cortex

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## Abstract

This article examines how approach motivation as indexed by electroencephalographic (EEG) asymmetry over the prefrontal cortex predicts purchase decision when brand and price are varied. In a within-subjects design, the participants were presented purchase decision trials with 14 different grocery products (7 private label and 7 national brand products) whose prices were increased and decreased while their EEG activity was recorded. The results showed that relatively greater left frontal activation (i.e., higher approach motivation) during the pre-decision period predicted an affirmative purchase decision. The relationship of frontal EEG asymmetry with purchase decision was stronger for national brand products compared to private label products and when the price of a product was below a normal price (i.e., implicit reference price) compared to when it was above a normal price. Higher perceived need for a product and higher perceived product quality were associated with greater relative left frontal activation.

Keywords: purchase decision, price, brand, electroencephalography, neurophysiology

# 1. Introduction

According to the neoclassical view of a rational Homo Economicus, humans make choices based on rational Bayesian maximization of expected utility, as if they were equipped with unlimited knowledge, time, and information-processing power (Naqvi, Shiv, & Bechara, 2006; Oullier, Kirman, & Kelso, 2008). This view has been challenged in different contexts, for example, in decision-making (Kahneman & Tversky, 1979) and in pricing (Monroe, 1973). A mounting body of evidence shows that emotional processes play a crucial role in economic decision making (e.g., Bernheim & Rangel, 2004; Kahneman, Ritov, & Schkade, 1999; Loewenstein & Lerner, 2003; Shiv & Fedorikhin, 1999; Slovic, Finucane, Peters, & MacGregor, 2004), and deficits in emotional processing can impair the quality of decision making (e.g., Bechara & Damasio, 2005). The present study was designed to examine how emotional-motivational factors as indexed by electroencephalographic (EEG) asymmetry over the prefrontal cortex predict purchase decision for national brand and private-label (grocery) products when their price levels were varied. We also examined the factors influencing frontal EEG asymmetry. We think that frontal EEG asymmetry can potentially broaden our view on emotional-motivational processes affecting purchase decision.

## 1.1 Frontal EEG Asymmetry and Approach/Withdrawal Motivation

According to Davidson's influential approach-withdrawal motivational model of emotion, the left- and right-anterior brain regions are part of two separate neural systems underlying approach and withdrawal motivation, respectively (e.g., Davidson, 1995, 2004). Relatively greater left frontal activity, either as a trait or a state, indicates a propensity to approach or engage a stimulus, while relatively greater right frontal activity indicates a propensity to withdraw or disengage from a stimulus (for reviews, see Coan & Allen, 2004; Davidson, 2003; Demaree, Everhart, Youngstrom, & Harrison, 2005). Source localization of frontal asymmetry in the alpha



frequency band (i.e., the index of frontal asymmetry in EEG studies) has indicated that it reflects activity in the dorsal prefrontal cortex (PFC; Pizzagalli, Sherwood, Henriques, & Davidson, 2005). Trait (resting) prefrontal EEG asymmetry has been shown to predict state-related emotional changes and responses (e.g., affective responses to emotional film clips; Wheeler, Davidson, & Tomarken, 1993) and to be associated with psychopathology or risk for psychopathology (especially depression and anxiety; e.g., Gotlib, Ranganath, & Rosenfeld, 1998; Wiedemann et al., 1999). Increased resting left-lateralized activity has also been associated with a stronger bias to respond to (monetary) reward-related cues (Pizzagalli et al., 2005). Likewise, resting-state hypoactivity in the right lateral PFC has been found to predict higher monetary risk taking (Gianotti et al., 2009) and a lower willingness to punish in the ultimatum game (Knoch, Gianotti, Baumgartner, & Fehr, 2010).

A relationship between emotional states and concomitant changes in frontal EEG asymmetry has also been established; that is, approach-related emotions (e.g., joy and anger) are associated with relatively greater left frontal activation, whereas withdrawal-related emotions (e.g., disgust and fear) are associated with relatively greater right frontal activation (e.g., Coan & Allen, 2003; Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Ekman & Davidson, 1993; Harmon-Jones, Sigelman, Bohlig, & Harmon-Jones, 2003). Davidson, Marshall, Tomarken, and Henriques (2000) have also argued that anterior asymmetry is associated with pre-goal attainment emotion elicited while attempting to achieve a goal (e.g., enthusiasm), but not with post-goal attainment emotion (e.g., contentment; cf. the distinction between wanting and liking; see also Tomarken & Zald, 2009). The state engagement in approach-related responses and perceived high as compared to low choice to engage in action (commitment to counterattitudinal or proattitudinal action) has been shown to increase left-sided frontal activity (Amodio, Devine, & Harmon-Jones, 2007; Harmon-Jones, Harmon-Jones, Serra, & Gable, 2011; see also Harmon-Jones, Lueck, Fearn, & Harmon-Jones, 2006).

## **1.2 Frontal EEG Asymmetry and Purchase Decision**

A consumer's purchase decision involves a tradeoff between the pleasure derived from benefits of a good and the pain of paying (; Monroe, 2003; Prelec & Loewenstein, 1998; Rao & Monroe, 1989; Zeithaml, 1988). That is, paying money triggers a perception of loss (i.e., prices are considered as a potential loss), even though it has also been suggested that money spent in buying goods is not 'coded' as a loss (no loss in buying hypothesis;

Bateman, Kahneman, Munro, Starmer, & Sugden, 2005). In regard to motivational tendencies, anticipatory pleasure of acquisition should be associated with approach motivation, whereas anticipatory pain of paying should be associated with withdrawal motivation. A situation where approach motivation elicited by a preferred product exceeds withdrawal motivation should be associated with an affirmative purchase decision. This (and the aforementioned suggestion that anterior asymmetry is associated with pre-goal attainment emotion, but not with post-goal attainment emotion) leads to our first hypothesis:

H1: Relatively greater left frontal activation during the pre-decision period (i.e., higher alpha asymmetry scores and approach motivation when seeing an image of a product) will predict an affirmative purchase decision, but the decision to purchase the product will not be associated with post-decision alpha asymmetry.

### **1.3 Price and Approach/Withdrawal Motivation**

Whereas a price increase from a reference point represents a loss, a price decrease from a reference point represents a gain (e.g., Hardie, Johnson, & Fader, 1993; Putler, 1992). It is also well established that consumers weigh losses from a reference point more heavily than equivalent sized gains, a phenomenon known as loss aversion (Tversky & Kahneman, 1991). Recently, using functional magnetic resonance imaging (fMRI), Knutson and co-workers found that positive product preference activated the nucleus accumbens (i.e., a brain region associated with anticipating gain), prices that were above individual's willingness to pay (WTP) activated the right insula (i.e., a region associated with anticipating loss), and prices that were below individual's WTP activated the mesial prefrontal cortex (i.e., a region that correlates with gain prediction errors) prior to the purchase decision (Knutson, Rick, Wimmer, Prelec, & Loewenstein, 2007). Importantly, activity from each of these regions independently predicted subsequent purchasing decisions. Specifically, the nucleus accumbens activation during seeing the product and the mesial prefrontal cortex activation during seeing the price predicted subsequent decision to purchase, while the right insula activation during seeing the price predicted subsequent decision not to purchase (Knutson et al., 2007). Thus, neural processes underlying purchase decisions may be different depending on whether the price of a product is below or above a reference price. It is also well known that perceptions of quality are positively correlated with price (Rao & Monroe, 1989). Recently, Plassmann, O'Doherty, Shiv, and Rangel

(2008) showed that high price level compared to low price level of a wine increased subjective reports of flavor pleasantness and activity in medial orbitofrontal cortex (i.e., a region thought to encode for experienced pleasantness during experiential tasks). This result suggests that high prices may elicit conflicting motivational tendencies (i.e., both withdrawal and approach motivation), which may mask the association of asymmetrical frontal cortical activity with a purchase decision. That being so, this association may be more evident when the price of a product is low. In the present study, we compared prices that were below product's normal selling price to prices that were above product's normal selling prices. Thus, our next hypothesis is:

H2: Relatively greater left frontal activation will be more strongly associated with an affirmative purchase decision when the price of a product is below a normal price compared to when it is above a normal price.

## **1.4 Brand and Approach/Withdrawal Motivation**

Evaluative judgments of brands can be based on two distinct types of information or inputs: (a) extrinsic and intrinsic cues (extrinsic cues are product related attributes like brand, packaging and intrinsic cues are related to physical product e.g. product nutrition; Monroe, 2003) and (b) experiential information (i.e., emotions and experiences evoked by the brand; Brakus, Schmitt, & Zarantonello, 2009; Pham, Cohen, Pracejus, & Hughes, 2001; Schwarz, 2004). Extrinsic and intrinsic information may be used in a systematic, step-by-step fashion (e.g., expectancy-value model, Fishbein & Ajzen, 1975) or heuristically (e.g., elimination-by-aspects, relational heuristics; for a review, see Bettman & Luce, 1998; see also Maheswaran, Mackie, & Chaiken, 1992). The process where judgments and decisions are based on subjective affective responses to the target, which appear to be seen as indicative of the target's value, has been referred to as the "How-do-I-feel about-it?" heuristic (involving conscious inspection of feelings toward the target; Pham, 1998; Pham et al., 2001) and the "affect heuristic" (encompassing conscious and non-conscious affective influences; Slovic, Finucane, Peters, & MacGregor, 2007). Likewise, the "somatic marker hypothesis", proposed by Damasio and colleagues, suggests that decision process is consciously or non-consciously influenced by marker signals that arise in bioregulatory processes expressing themselves in emotions and feelings (e.g., Bechara & Damasio, 2005). Through learning

and experience, images of options become “marked” by positive and negative feelings linked directly or indirectly to somatic or bodily states.

Brand associations are formed when interacting with the brand (e.g., store visits and actual consumption) and during prior indirect brand exposures (e.g., via brand communications; Esch et al., 2012). Strong (familiar) brands have been suggested to have stronger and more positive brand associations compared to weak (familiar) brands and unfamiliar brands (e.g., Hoeffler & Keller, 2003). Recently, a brain-imaging study by Esch et al. showed that, when evaluating brands, strong brands elicited activations of the pallidum associated with positive emotions, whereas weak and unfamiliar brands elicited activations of the insula associated with negative emotions. In the present study, we focus on national brand and private-label products. Previous research suggests that the influence of deviations from the reference price on purchase behavior may be different for national brand products and private-label products (for the moderating role of quality-tiers in loss aversion, see Hankuk & Aggarwal, 2003). Consumers tend to perceive brands in the high-quality tier (e.g., national brands) as offering “comfort, security, and value”, whereas brands in the low-quality tier (e.g., private-label brands), offer lower prices but lower quality too (Hankuk & Aggarwal, 2003). It is also possible that images of private-label products are not marked by strong positive and negative affective feelings; rather, the associations may be neutral. Thus, purchase objectives and psychological processes underlying purchase decision may be different for national brand products and private-label products. Given the discussion above, it would be expected that emotional-motivational factors play a greater role in determining purchase decision for national brand products compared to private-label products. This leads to the following hypothesis:

H3: Relatively greater pre-decision left frontal activation will be more strongly associated with an affirmative purchase decision for national brand products compared to private label products.

### **1.5 Perceived Need, Product Quality, and Frontal EEG Asymmetry**

We also examined the predictors of frontal EEG asymmetry. Hunger and thirst—signals of biological needs—lead to the motivation to get food and water (i.e., appetitive/approach motivation). Likewise, a consumer's motivation to purchase a product or service is triggered by an expectation that the object of purchase will satisfy his or her perceived biological or other needs. Recently, Gable and Harmon-Jones (2008) showed that self-

reported liking for dessert and time since eaten were associated with greater relative left frontal EEG activation during viewing dessert pictures, but not during viewing neutral pictures. Thus, cues signaling potential satisfaction of perceived needs would be expected to elicit approach motivation and relatively greater left frontal activation.

Product attributes, such as perceived quality (i.e., a consumer's judgment about the overall superiority or excellence of a product; Zeithaml, 1998), may also exert an influence on approach motivation. As noted above, consumers tend to anticipate that high-quality products will offer "comfort, security, and value" (Hankuk & Aggarwal, 2003). Thus, images of high-quality products are expected to be marked by positive feelings, thereby eliciting approach motivation. This leads to the following hypothesis:

H4: a) Higher perceived need for a product and b) higher perceived product quality will be associated with greater relative left frontal activation during the pre-decision period (when seeing an image of a product).

## 2. Methods

### Participants

The participants were 33 right-handed healthy business students (14 males and 19 females), who ranged from 20 to 44 years of age (mean = 27.0). All participants were students who were responsible for their own household's grocery purchases.

### Design

A 7 (Product Category)  $\times$  2 (Brand)  $\times$  15 (Price) within-subjects design was employed.

Seven product categories were selected for the research: detergent, chocolate, coffee, chips, orange juice, chocolate cookies, and toothpaste. For each product category, two products were selected: one national brand product and one store-labeled product (altogether 14 different products). We selected product categories from which two products could be found that are nearly equal in other components except the product wrapping and brand. The selected national brand products were the market leaders of that product category. A corresponding product was selected from the private label category.

The third factor, price, included 15 different price levels plus one duplicate for the normal price level to allow us to control the participant consistency. Altogether, each product was presented 16 times (16 trials). Each product's selling price at a local supermarket was selected as a normal price level. The prices varied from normal price level  $\pm$  3%, 6%, 10 %, 25 %, 40 %, 60 %, and 75 %. Since each product has an individual normal price level, a variable called price multiplier presents the different price levels for each product. The levels of price multiplier are 0.25, 0.4, 0.6, 0.75, 0.9, 0.94, 0.97, 1, 1.03, 1.06, 1.10, 1.25, 1.4, 1.6, 1.75 (1=product's normal price, 0.25=normal price minus 75%, 1.75=normal price plus 75% etc.) List of all products and their price levels are presented in Appendix A. The behavioral

data (the influence of a price decrease and increase on buying behavior) have been reported in Somervuori and Ravaja (2011).

## **Product Ratings**

After the experiment, the participants filled in a questionnaire in the Internet where they rated their perception on each products' quality and need. Perceived product quality was rated on a 5-point scale, ranging from 1 (*poor quality*) to 5 (*high quality*). Perceived need for the product was also rated on a 5-point scale, ranging from 1 (*not at all*) to 5 (*very much*).

## **Procedure**

In the laboratory, the participant was first given instructions on the task and tested for task comprehension. After the briefing, the participant filled out an informed consent form. Electrodes were then attached, and the participant was seated on a chair. The participant was left alone in the laboratory for a 7-min rest period, followed by the experiment that took, on the average, 52 minutes. The participants received 40 € in cash to spend on products during the experiment. They were asked to imagine themselves grocery shopping in a local supermarket and having 40 € (their endowment) to spend. All participants were presented with 224 trials in a random order. Each of the 224 trials consisted of the following phases: (a) a fixation cross on a screen presented for 1 s to focus the attention of the participant to the middle of the screen (fixation period), (b) an image of a product with a price shown for 6 s (pre-decision period), (c) a prompt on the screen to choose either to purchase the product or not by selecting either Y for yes or N for no, and (d) an interstimulus interval varying randomly from 7 to 9 s while the screen was black. The trials were presented using Presentation 10.4 software.

To ensure the participant's engagement in the purchasing task, one trial for each product was randomly selected to count for real (participants were informed about this in the beginning of the experiment). If the participant had chosen to purchase the product in the randomly selected trial, they paid the price shown in the trial from their endowment. In return for their participation, the participants could keep the purchased products and that part of the endowment they had not spent when leaving the experiment. In addition, the participants were introduced a bonus schema where they were able to gain additional 5 € bonus if they answered "yes" for more than 30 % of the trials.

The experiment seeks to simulate normal shopping situation. Participant engagement was critical to ensure elicitation of psychophysiological reaction therefore real money was given to participants and real products were purchased. In addition, the participants were well motivated to reveal their true willingness-to-pay (WTP) for all products since only one trial out of each product was randomly selected to count for real. Participants were motivated not to underestimate the WTP since in a lottery there is a risk of regret of not being able to purchase a product with low price if WTP is underestimated. On the other hand, since the participants had to pay real money the participants would not overestimate their WTP either. The sufficiently large number of products ensured that all participants were interested in many products. The fact that all participants were not interested in all products corresponds to a normal market situation. Local grocery stores also have similar bonus schemas as introduced in the experiment. Typically, in the end of each month/year, each grocery store delivers some bonus back to their customers. Therefore, the bonus is not assumed to create un-normal behavior. In addition, the bonus schema balances out the de-motivational aspects of laboratory setting.

To avoid learning effect the trials were presented in a completely random order. Since there were a large number of trials and no indication whether the price shown was normal, low or high, the participants were not able to learn the pricing structure to form strategic behavior. In addition, the statistical tests indicated that the trial order did not have significant influence on purchase behavior. After finishing with all trials, the electrodes were removed, and the participant was debriefed and thanked for participation.

## **Assessment of EEG**

Electrodes mounted in a stretch-Lycra cap (Electrocap; Electro-Cap International, Eaton, OH) were used to record EEG activity from left and right frontal (F3, F4), central (C3, C4), temporal (T7, T8), parietal (P3, P4), and occipital (O1, O2) scalp sites (10–20 International System; Jasper, 1958). The electrodes were referred to linked ears, and the ground lead was located at the left collarbone (e.g., Harmon-Jones & Allen, 1998). Electrode impedances were reduced to less than 5 k $\Omega$ . All signals were amplified by a factor of 50,000 with the Psylab EEG8 amplifiers (Contact Precision Instruments, London, UK). During the data collection, 1-Hz high-pass and 200-Hz low-pass filters were used; a 50-Hz notch filter was also employed. To facilitate artifact detection, ocular movements were recorded with two electrooculogram (EOG) channels. For vertical eye-movements, the



electrodes were placed below and above the right eye; for horizontal eye-movements, the electrodes were placed at the outer canthi of the left and right eye. The data collection was controlled by Psylab SAM2 software, and all signals were sampled at a rate of 1000 Hz.

## **Data Reduction and Analysis**

After the recordings, the EEG data were filtered with 0.5-Hz high-pass and 70-Hz low-pass filters. For each trial, the EEG data were segmented into three 1-s epochs before stimulus (image of a product) onset (Seconds 1 to 3) and eight 1-s epochs after stimulus onset (Seconds 4 to 11). For artifact removal, all 1-s epochs containing activity outside the range of  $-85 \mu\text{V}$  to  $+85 \mu\text{V}$ , on any of the EEG or EOG channels, were detected and removed from further analyses. For all the remaining 1-s epochs, the power spectra were derived by the fast Fourier transform (FFT) method with a Hanning window (applied to the distal 10% at each end of the epoch). Power values (in  $\mu\text{V}^2$ ) within the alpha (8-12 Hz; Buzsáki, 2006) frequency range were extracted for each 1-s epoch (in alpha asymmetry research, the 8–13 Hz frequency band has also been used; Allen, Coan, & Nazarian, 2004). Mean power density values were derived for the following periods: (a) baseline (Seconds 1 and 2; i.e., two seconds preceding the fixation period), (b) pre-decision period (Seconds 4 to 9), and (c) post-decision period (Seconds 10 and 11; for another example of short stimulus periods, i.e., 3-s affective picture viewing, in alpha asymmetry research, see Harmon-Jones et al., 2006). As in previous research (Allen et al., 2004), a frontal asymmetry index (natural log of alpha power on the right minus natural log of alpha power on the left) was computed for each period, using midfrontal sites (F3, F4). Since cortical alpha power is inversely related to cortical activity (Lindsley & Wicke, 1974), higher scores on the index indicate greater relative left hemisphere activity. Change scores for alpha asymmetry ( $\Delta$  alpha asymmetry) were computed by subtracting baseline alpha asymmetry from pre-decision alpha asymmetry and post-decision alpha asymmetry (cf. Allen, Harmon-Jones, & Cavender, 2001; Papousek & Schulter, 2002); these change scores reflected changes in asymmetry from the (local) baseline of each trial.

All data were analyzed using the Generalized Estimating Equations (GEE) procedure in SPSS. In the GEE procedure, the dependent variable is linearly related to the factors and covariates via a specified link function. The model allows for the dependent variable to have a non-normal distribution and covers widely used statistical models (e.g., logistic models for binary data). The GEE procedure extends the generalized linear model

to allow for analysis of repeated measurements or other correlated observations. The GEE approach requires the specification of the correlation structure of the repeated observations of the dependent variable, distribution of the dependent variable, and link function. The GEE models were introduced by Liang and Zeger (1986), and the method has received wide use in medical and life science research (Ballinger, 2008).

We specified participant ID as the subject variable and trial number as the within-subject variable. On the basis of the Quasi-likelihood under Independence Model Criterion (QIC), we specified unstructured as the structure of the working correlation matrix. When predicting purchase decisions, we specified a binomial distribution with logistic link. When predicting EEG alpha asymmetry, we specified a normal distribution with identity as the link function. The terms included in different models are described under the Results section.

### 3. Results

Table 1 shows the results of the GEE analyses for purchase decision. The results of the GEE analysis for EEG alpha asymmetry are shown in Table 2. The purchase decision was affirmative in 38% of the trials ( $n = 224$ ).

#### **Hypothesis 1**

Hypothesis 1 predicted that relatively greater left frontal activation during the pre-decision period (i.e., higher alpha asymmetry scores and approach motivation when seeing an image of a product) will predict an affirmative purchase decision, but the decision to purchase the product will not be associated with post-decision alpha asymmetry. When testing Hypothesis 1 and Hypothesis 2, product category, normal price, price multiplier,  $\Delta$  alpha asymmetry, and the Dichotomized Price Multiplier  $\times$   $\Delta$  Alpha Asymmetry interaction were included in the GEE model. As predicted, the results revealed a significant main effect for pre-decision  $\Delta$  alpha asymmetry in predicting purchase decision,  $p < .001$ . That is, the relatively greater left frontal activation was (i.e., higher approach motivation), the more likely the participant was to purchase a product. In disagreement with Hypothesis 1, also high post-decision  $\Delta$  alpha asymmetry scores were significantly related to an affirmative purchase decision,  $p < .001$ .

Variable	<i>B</i>	<i>SE</i>	Wald $\chi^2$	df	<i>p</i>
Hypothesis 1 (Pre-decision asymmetry)					
(Intercept)	4.740	.224	449.24	1	<.001
Product category					
Detergent	0.913	.130	49.30	1	<.001
Chocolate	0.065	.107	0.37	1	.546
Chips	0.378	.100	14.14	1	<.001
Coffee	0.459	.112	16.75	1	<.001
Chocolate cookies	0.402	.114	12.45	1	<.001
Orange juice	0.075	.101	0.56	1	.455
Toothpaste	0 <sup>a</sup>				
Normal price	-0.996	.067	219.68	1	<.001
Price multiplier	-3.117	.166	351.10	1	<.001
$\Delta$ Alpha asymmetry <sup>b</sup>	0.199	.034	33.62	1	<.001
Dichotomized Price Multiplier $\times$ $\Delta$ Alpha Asymmetry <sup>b</sup>	-0.247	.045	30.04	1	<.001
Hypothesis 1 (Post-decision asymmetry)					
(Intercept)	3.790	.162	550.90	1	<.001
Product category					
Detergent	0.761	.086	78.53	1	<.001
Chocolate	0.102	.095	1.16	1	.282
Chips	0.467	.081	32.87	1	<.001
Coffee	0.167	.074	5.13	1	.024
Chocolate cookies	0.675	.091	54.84	1	<.001
Orange juice	-0.035	.086	0.16	1	.687
Toothpaste	0 <sup>a</sup>				
Normal price	-0.963	.036	719.21	1	<.001
Price multiplier	-3.073	.100	949.09	1	<.001
$\Delta$ Alpha asymmetry <sup>b</sup>	0.210	.028	56.88	1	<.001
Dichotomized Price Multiplier $\times$ $\Delta$ Alpha Asymmetry <sup>b</sup>	-0.322	.035	86.72	1	<.001
Hypothesis 2 (Pre-decision asymmetry)					
(Intercept)	4.272	.168	649.89	1	<.001
Normal price	-0.701	.038	340.54	1	<.001
Price multiplier	-3.292	.148	498.22	1	<.001
Brand	-0.513	.079	42.04	1	<.001
$\Delta$ Alpha asymmetry <sup>b</sup>	0.059	.013	20.52	1	<.001
Brand $\times$ $\Delta$ Alpha Asymmetry <sup>b</sup>	0.074	.035	4.50	1	.034
Hypothesis 2 (Post-decision asymmetry)					
(Intercept)	3.167	.133	570.78	1	<.001
Normal price	-0.567	.046	151.10	1	<.001
Price multiplier	-2.947	.084	1231.33	1	<.001
Brand	-0.330	.061	29.39	1	<.001
$\Delta$ Alpha asymmetry <sup>b</sup>	0.026	.020	1.73	1	.189
Brand $\times$ $\Delta$ Alpha Asymmetry <sup>b</sup>	0.269	.025	113.80	1	<.001

Table 1 Results of Generalized Estimating Equations (GEE) Analysis of Purchase Decision Data

Note. For purchase decision, 0 = not buying (reference category), 1 = buying.

<sup>a</sup>Set to zero because this parameter is redundant.

<sup>b</sup>Pre-decision alpha asymmetry ( $\ln[F_4/F_3]$ ) minus baseline alpha asymmetry.

## Hypothesis 2

Hypothesis 2 suggested that relatively greater left frontal activation will be more strongly associated with an affirmative purchase decision when the price of a product is below the normal price compared to when it is above the normal price. The results showed that, in addition to the significant

main effect for  $\Delta$  alpha asymmetry, there was a significant Dichotomized Price Multiplier  $\times$  (Pre-Decision)  $\Delta$  Alpha Asymmetry interaction in predicting purchase decision,  $p < .001$ . That is, as predicted, pre-decision  $\Delta$  alpha asymmetry was positively related to an affirmative purchase decision when the price of a product was below the normal price, but not when it was above the normal price (see the top panel of Figure 1). The results revealed also a significant Dichotomized Price Multiplier  $\times$  (Post-Decision)  $\Delta$  Alpha Asymmetry interaction for purchase decision,  $p < .001$ . As was the case for pre-decision  $\Delta$  alpha asymmetry, post-decision  $\Delta$  alpha asymmetry was associated with an affirmative purchase decision only when the price of a product was below the normal price.

### **Hypothesis 3**

Hypothesis 3 suggested that relatively greater left frontal activation would be more strongly associated with an affirmative purchase decision for national brand products compared to private label products. When testing Hypothesis 3, normal price, price multiplier, brand,  $\Delta$  alpha asymmetry, and the Brand  $\times$   $\Delta$  Alpha Asymmetry interaction were included in the GEE model. The results showed that both the Brand  $\times$  (Pre-Decision)  $\Delta$  Alpha Asymmetry interaction and Brand  $\times$  (Post-Decision)  $\Delta$  Alpha Asymmetry interaction were significant in predicting purchase decision,  $p = .034$  and  $< .001$ , respectively. In agreement with Hypothesis 3, pre-decision and post-decision  $\Delta$  alpha asymmetry scores were more strongly positively associated with an affirmative purchase decision for national brand products compared to private label products (see the bottom panel of Figure 1).

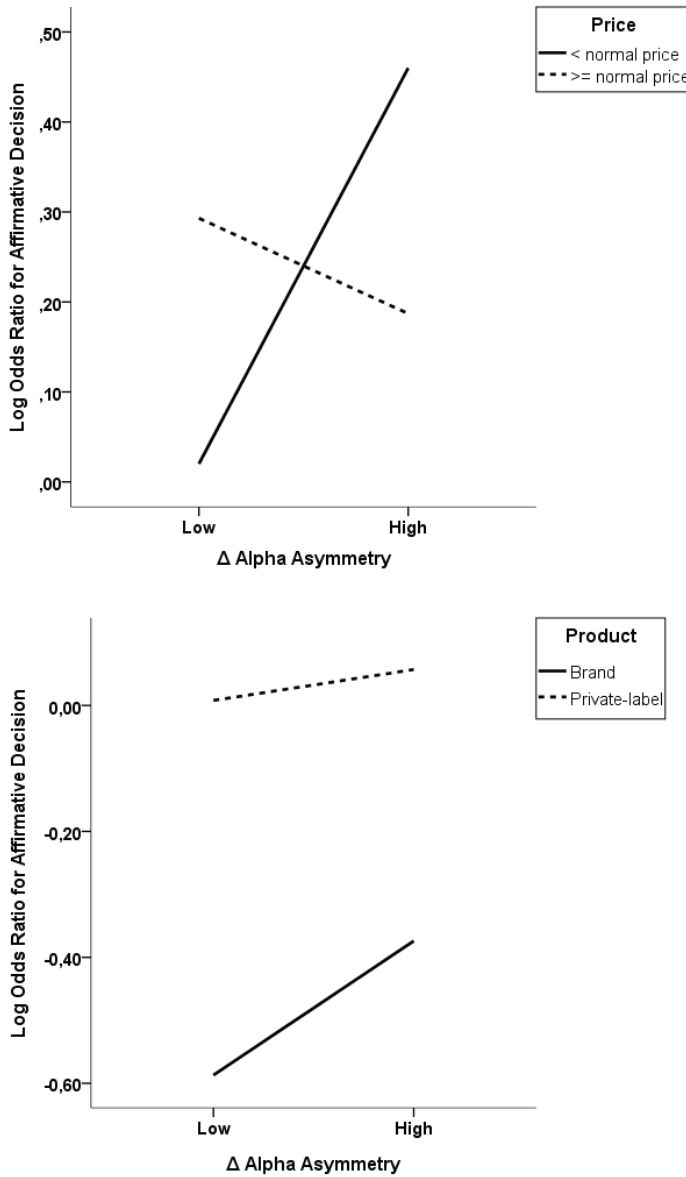


Figure 1. The relationship of pre-decision  $\Delta$  alpha asymmetry with purchase decision as a function of dichotomized price multiplier (top panel) and product (national brand or private label; bottom panel; low  $\Delta$  alpha asymmetry =  $M - 1.5$  SD; high  $\Delta$  alpha asymmetry =  $M + 1.5$  SD).

#### Hypothesis 4

Hypothesis 4 predicted that higher perceived product quality and need would be associated with relatively greater left frontal activation during the pre-decision period (i.e., higher approach motivation when seeing an image of a product). When testing Hypothesis 4, perceived product quality and

need for the product were included in the GEE model. As predicted, the results revealed significant main effects for both perceived product quality,  $B = .009$ ,  $SE = .003$ ,  $\text{Wald}\chi^2 (df = 1) = 8.80$ ,  $p = .003$ , and perceived need,  $B = .016$ ,  $SE = .002$ ,  $\text{Wald}\chi^2 (df = 1) = 45.32$ ,  $p < .001$ , in predicting pre-decision  $\Delta$  alpha asymmetry. That is, both perceived product quality and perceived need were positively associated with relatively greater left frontal activation.

## 4. Discussion

In the present investigation, the authors examined (a) how approach motivation as indexed by EEG asymmetry over the prefrontal cortex predicts purchase decision for national brand and private-label (grocery) products when their prices were varied and (b) the factors influencing frontal EEG asymmetry.

### 4.1 Frontal EEG Asymmetry and Purchase Decision

As hypothesized, we found that relatively greater left frontal activation during the pre-decision period (i.e., higher approach motivation when seeing an image of a product) predicted an affirmative purchase decision. This is the first study to show that frontal EEG asymmetry predicts purchase decision. The present finding supports the view that a situation where approach motivation evoked by anticipatory pleasure of acquisition exceeds withdrawal motivation evoked by anticipatory pain of paying is associated with an affirmative purchase decision (Dodds, Monroe, & Grewal, 1991; Monroe, 2003; Prelec & Loewenstein, 1998; Zeithaml, 1988). As opposed to our expectation, we found that also relatively greater post-decision left frontal activation was related to an affirmative purchase decision. This finding appears to be in disagreement with the suggestion that anterior asymmetry is associated with pre-goal attainment emotion, but not with post-goal attainment emotion (Davidson et al., 2000). However, the present study design was not optimal for testing the latter part of our hypothesis, given the procedure that, after completing all trials, only one trial/decision for each product was randomly selected to count for real. That is, at the time of the decision, the participant didn't know whether he or she had really achieved his or her goal (whether an affirmative purchase decision resulted in acquisition of a preferred product). In effect, the fact that both relatively greater pre-decision and post-decision left frontal activation was related to an affirmative purchase decision increases our confidence in the present findings (Type I error is less likely).



## **4.2 The Moderating Influence of Price and Brand**

As also expected, the results showed that greater relative left frontal activation was more strongly related to an affirmative purchase decision when the price of a product was below the normal price compared to when it was above the normal price. This was the case for both pre-decision and post-decision alpha asymmetry, again increasing our confidence in the finding. Our finding may suggest that there are conflicting motivational tendencies (i.e., both withdrawal and approach motivation) when the price of a product is above the normal price, which may mask the association of frontal EEG asymmetry with a purchase decision. That is, a price increase from a reference point represents a loss (e.g., Hardie et al., 1993; Putler, 1992), which would be expected to elicit withdrawal motivation. However, high price may also elicit a perception of higher quality, thereby potentially eliciting also approach motivation (Dodds, Monroe, & Grewal, 1991; Monroe, 2003; Zeithaml, 1988). The present finding is also in line with the suggestion that neural processes underlying purchase decisions are different depending on whether the price of a product is below or above a reference price (Knutson et al., 2007).

We also found that greater relative left frontal activation was more strongly associated with an affirmative purchase decision for national brand products compared to private-label products. Again, this was the case for both pre-decision and post-decision alpha asymmetry. This finding suggests that emotional-motivational factors play a greater role in determining purchase decisions for national brand products compared to private-label products. This finding is in line with suggestion that buyers use external cues (e.g. perceived brand name) to assess the product quality (Monroe, 2003). Brand associations have previously been suggested as being stronger and more positive for strong (familiar) brands compared to weak (familiar) brands and unfamiliar brands (e.g., Hoeffler & Keller, 2003). The present results suggest that images of private-label products may not be marked by strong positive or negative affective feelings (see e.g., Bechara & Damasio, 2005); the brand associations for private-label products may rather be neutral. Apparently, not only purchase objectives but also psychological processes underlying purchase decision are different for national brand products and private-label products.

### **4.3 Predictors of Frontal EEG Asymmetry**

In agreement with our hypothesis, the results showed that higher perceived need for the product was associated with greater relative left frontal EEG activation during the pre-decision period (when seeing an image of a product). Given that a need elicits appetitive/approach motivation, this finding supports the validity of frontal EEG asymmetry as a measure of approach motivation. The present finding is in line with the view that a consumer's motivation to purchase a product or service is triggered by an expectation that the object of purchase will satisfy his or her perceived needs. It is also in line with prior research showing that time since eaten (indexing a biological need) was associated with greater relative left frontal EEG activation during viewing dessert pictures, but not during viewing neutral pictures (Gable & Harmon-Jones, 2008). We also found that higher perceived product quality was related to greater relative left frontal activation during the pre-decision period. Given that high-quality products are anticipated as offering "comfort, security, and value" (Hankuk & Aggarwal, 2003), their images are expected to be marked by positive feelings, thereby eliciting approach motivation.

### **4.4 Limitations**

Although the research design used in the present study entails the advantage that the decisions made by the participants have real monetary consequences for them, an apparent limitation was that the decision making situation, nevertheless, differs from that typical for purchasing grocery products (the present situation resembles, to some extent, a web auction). It is unclear, however, whether this difference should have any influence on the results obtained. It should also be noted that the present results apply to grocery products of relatively low price. One may expect, however, that the results would have been even stronger for more expensive products.

An additional limitation relates a procedural issue that produces interpretational difficulties. As has been customary in most of the previous research, we quantified asymmetry as the difference between right frontal activation and left frontal activation. This computation of asymmetry implies that there is a single bipolar (reciprocal) continuum of cortical activation, thereby being in contrast with the view that approach and withdrawal motivation are largely independent (Ito & Cacioppo, 1999). It is also of note that several different patterns of activation may be represented by the same asymmetry score (e.g., a moderate asymmetry score can

indicate either high left and high right frontal activation or low left and low right frontal activation).

Finally, it might have been advantageous to have a separate product period (image of a product without a price) and a price period (image of a product with a price) in the trials of the experiment (see Knutson et al., 2007). This would have been optimal for studying separately the approach/withdrawal motivation elicited by preferred products and prices, although the present factorial design varying the product and price is basically also able to tease out this information.

## **4.5 Conclusions**

The present study showed that greater relative left frontal EEG activation during the pre-decision period predicted an affirmative purchase decision for grocery products. This relationship was stronger when the price of a product was below a normal price (implicit reference price) compared to when it was above a normal price, suggesting that there may be conflicting motivational tendencies (i.e., both withdrawal and approach motivation) when the price of a product is above the reference price. The results also suggested that emotional-motivational factors play a greater role in determining purchase decision for national brand products (the images of which are marked by strong affective feelings) compared to private-label products. In general, the results provide further evidence for the importance of emotional-motivational factors in purchase decision. This study also supports the usefulness of frontal EEG asymmetry as a measure of approach/withdrawal motivation when studying purchase decision. Frontal EEG asymmetry adds a new dimension to our understanding of emotional-motivational processes affecting purchase decision—a dimension that we cannot necessarily tap, if we only record behavioral responses.

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Prices in EUR		Price multiplier													
Product	0.25	0.4	0.6	0.75	0.9	0.94	0.97	1	1.03	1.06	1.1	1.25	1.4	1.6	1.75
Chips National Brand	0.65	1.04	1.55	1.94	2.33	2.43	2.51	2.59	2.67	2.75	2.85	3.24	3.63	4.14	4.53
Chips Private Label	0.28	0.46	0.68	0.85	1.02	1.07	1.1	1.14	1.17	1.21	1.25	1.42	1.59	1.82	1.99
Chocolate National Brand	0.42	0.68	1.01	1.27	1.52	1.59	1.64	1.69	1.74	1.79	1.86	2.11	2.37	2.7	2.96
Chocolate Private Label	0.29	0.46	0.69	0.86	1.04	1.08	1.12	1.15	1.18	1.22	1.27	1.44	1.61	1.84	2.01
Coffee National Brand	0.82	1.32	1.97	2.47	2.96	3.09	3.19	3.29	3.39	3.49	3.62	4.11	4.61	5.26	5.76
Coffee Private Label	0.35	0.56	0.83	1.04	1.25	1.31	1.35	1.39	1.43	1.47	1.53	1.74	1.95	2.22	2.43
Cookie National Brand	0.41	0.66	0.99	1.23	1.48	1.54	1.59	1.64	1.69	1.74	1.81	2.05	2.3	2.63	2.87
Cookie Private Label	0.26	0.42	0.63	0.79	0.95	0.99	1.02	1.05	1.08	1.11	1.16	1.31	1.47	1.68	1.84
Detergent National Brand	0.7	1.12	1.67	2.09	2.51	2.62	2.71	2.79	2.87	2.96	3.07	3.49	3.91	4.46	4.88
Detergent Private Label	0.33	0.53	0.79	0.98	1.18	1.23	1.27	1.31	1.35	1.39	1.44	1.64	1.84	2.1	2.3
Orange juice National Brand	0.74	1.18	1.77	2.21	2.66	2.77	2.86	2.95	3.04	3.13	3.25	3.69	4.13	4.72	5.16
Orange juice Private Label	0.16	0.26	0.39	0.49	0.59	0.61	0.63	0.65	0.67	0.69	0.72	0.81	0.91	1.04	1.14
Toothpaste National Brand	0.44	0.7	1.05	1.31	1.58	1.64	1.7	1.75	1.8	1.86	1.93	2.19	2.45	2.8	3.06
Toothpaste Private Label	0.17	0.26	0.4	0.5	0.59	0.62	0.64	0.66	0.68	0.7	0.73	0.83	0.92	1.06	1.16

Appendix A. List of all products and their price levels



Behavioral pricing views prices and pricing in relation with their human elements – that is how people attend to, perceive, process, and evaluate price information. These viewpoints are influenced by psychological and behavioral factors that typically are not considered when setting prices. The scarce attention paid to psychology by economists began with the neoclassical revolution. Economists thought that psychology provided too unsteady foundation for economics. Nowadays, the behavioral perspective has been more widely studied. This research reviews the behavioral pricing literature in general and concentrates especially on reference price and how people react to prices that are above and below the reference price. Furthermore, this research looks at the emotional and motivational responses elicited by price changes measured with psychophysiological methods (e.g. EEG and electrodermal activity). These measures are widely used in psychology; however, very little if at all in pricing studies.



ISBN 978-952-60-4797-3  
ISBN 978-952-60-4798-0 (pdf)  
ISSN-L 1799-4934  
ISSN 1799-4934  
ISSN 1799-4942 (pdf)

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